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ELEMENTS

OF

CORRECT TECHNIQUE.

CLINICS

FROM THE

New York School of Special Electro-therapeutics.

BY

S. H. Monell, M. D.

(*New York.*)

Founder and Chief Instructor of the New York School of Special Electro-therapeutics, succeeding the Brooklyn Post-Graduate School of Clinical Electro-therapeutics and X-Ray Technique; Professor of Static Electricity in the International Correspondence Schools; Member of the New York County Medical Society; Member of Kings County Medical Society; Charter Member of the Roentgen Society of the United States; Formerly Editor of the Electro-therapeutic Department of the Medical Times and Register, 1894–98; Author of "Manual of Static Electricity in X-Ray and Therapeutic Uses"; "The Treatment of Disease by Electric Currents"; The Cure of Writers Cramp and the Arm Troubles of Telegraphers and Ball Players"; "Rudiments of Modern Medical Electricity"; etc., etc.

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PREFACE.

After four years of teaching physicians how to acquire skill in Electro-Therapeutic technique my general missionary work in this field ends. Henceforward the teaching that I do will be confined to my personal methods of employing static electricity which take this great agent from out the rut of routine abuse and make it an instrument of scientific precision and of extraordinary utility.

As a substitute for my clinical instruction this book is designed to furnish physicians a series of practical Home-Clinics and personal tests of current action which will transform the novice into an expert with reasonable study. Much original information is also added.

This Manual is supplementary to my other books and covers other ground. It teaches the physician to explore electric currents at home. Much of the matter in these chapters is not in print elsewhere, and is not included in either clinical or correspondence instruction at present. Accurate selection, precise dose regulation, approved methods, the art of artistic technique, progressive efficiency and superior therapeutic results, are placed at the command of the careful student of this book.

S. H. Monell, M. D.

New York, September 20, 1900.

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INTRODUCTION.

TECHNIQUE.

Technique is the term which expresses *manual dexterity in the use of tools employed by definite methods for definite ends.* It does not refer simply to the methods or forms of applying electricity without regard to the skill and dexterity of the application. One of the most amazing phases of professional attitude toward any remedial agent must be considered the idea that electricity can be prescribed without learning anything about how to use it. Perhaps still more amazing to the expert is the idea held by many that there is nothing in particular to learn about the use of electricity. I have been teaching physicians the practical side of electro-therapeutics since 1896. Among those who have come to me as pupils have been men with large previous experience, and some who have had much previous instruction elsewhere, but none have appeared to grasp the true idea of technique until my object-lessons unfolded it. Very few of my students have recognized how dexterity can transform a method from *mechanics* into *art* until I taught them. Then they have wondered that they had been so blind to the rich resources unlocked by simple skill. When the scales have dropped from their own eyes they have wondered how the rest of the profession could remain so blind to so obvious a thing. I have watched a beginner strive for twenty-five minutes to relieve the pain of coccygodynia with a static spray and make no headway whatever. I have taken the same electrode from him and with the same current and same method have removed the pain in half a minute.

Technique is the secret of my results. So few yet understand the scope for *trained manual dexterity* in electro-therapeutics that familiar comparison will be profitable. For instance, a traveling artist puts on the stage a board and an easel. On a table he has a dozen balls of clay. His tools are his hands and brain. Nothing more. He quickly throws, one after the other, four clay balls at the center of the board and they stick there and form a mound. What could you do with the mound?

What does the artist do? His hands push, press and shape the mass while the audience gazes. In thirty seconds a face appears—in forty seconds it is a finished historical portrait. An Arab's head in thirty seconds, a baby's face in twenty seconds, a naval hero in forty seconds, timed by my own watch, are shaped in rapid order from the same clay; and as fast as one is seen complete he batters in the face and moulds another. He spends *fifty* seconds on the head of Lincoln to give it more perfect finish; but which of my readers could model the head of Lincoln in a day? Does skill mean nothing in electro-therapeutics?

Put a standard cartridge in a standard rifle and shoot it yourself at some glass balls thrown in the air some yards away. Is your technique able to break one ball out of a dozen? Yet scores of experts can break ninety out of a hundred with the same gun. Is the difference in results in the gun or in the marksman?

Take the familiar typewriter. With what difficulty and care you would, if a novice, fill up a single page with words and errors spelled out at the toilsome rate of three or six a minute. But thousands of operators possess a dexterity in technique which enables them to do the same thing at the rate of more than a hundred words a minute. Some can even hide the keys with a cloth and yet strike each letter as rapidly as before. If you had equal skill with the manipulation of electric currents could you not make them do more than a novice?

Once more: Take four strings, a bow and the wooden box called a violin. Sweep the bow over the strings and try to make agreeable music out of it. If you lack the musician's technique you will scrape the strings in vain. In fact, judging solely by your efforts, a bystander might say that no one could play a pleasing tune on such an instrument. Physicians have judged the merits of electricity on similar evidence.

But hand the instrument to a master—how his dexterity of technique transforms it!

It is plain that in every branch of achievement skill surpasses the efforts of the untrained hand with the same tools and the same conditions in the same work. We all admit this about other things, but how many physicians apply the same rule to the employment of electricity? Perhaps the estimate of a late distinguished neurologist, 2 per cent., was as near the mark as could be stated. Yet not only is there a great difference in the results when a master takes the electrodes from the novice, but the work will be done with an elegance, precision, comfort, confidence and quickness that will stamp the value of technique upon the patient's mind forever.

There is the same need of skill in electro-therapeutics that there is in the finest surgery, yet few think it needful to acquire it. Every physician is a novice in the use of electro-therapeutic tools when he begins his practice, and in the past too many have remained novices to the end of their experience. When they have learned one tune with a few variations they have lingered at the same point of skill thereafter. That is just what the itinerant does who grinds a hand-organ day after day up the same street. The music (?) of the hand-organ is written in one key. It lacks quality, variety and expression. It lacks the artist! So does electro-therapeutics when physicians treat apparatus as a hand-organ and grind out only the usual mechanical routine; when the static spark is used like a blunderbuss or club; when the possible re-

finements of galvanic technique are lost in directions to a nurse or to the patient to "get a battery and try electricity himself"; when induction coil currents are sought from the common faradic battery; when competent and complete electrodes are regarded as unnecessary, and when the value of scientific instruction is almost wholly ignored.

Occasionally I meet a physician who has worked out a fair degree of skill in his own office and largely with the help of my books, and to all who would earnestly pursue home study I offer the practical aid of this manual to supplement my other writings on the subject. It is true that the "touch" of a Paderewski, the "aim" of a Bogardus, the "genius" of a Rousseau, or the exact knack of my own technique cannot be put into written words, but I shall be as plain as possible and believe that this book will be of greater assistance to beginners than anything short of my personal object lessons. Those who carefully repeat and study the tests here outlined for each current will find that they have laid an excellent foundation for the successful treatment of their patients. Begin and persevere and the rest will follow. Do not make a test once and drop it, but get all the meaning out of it before you pass on to something else. In connection with any given set of experiments study the *physiological actions* of the current in question. Apply the same rule that you would adopt in the study of drugs. You would study actions and dosage together. Do the same thing with electricity. Never think any detail too small to be important. Never neglect any detail that will contribute to the *comfort* of a patient, even if it is not a part of the therapeutic action. Never hurt a patient. Never fatigue a patient. Never startle a patient. Be sure of your ground before you go ahead with any new application you may read about in some article or book. Distrust vague recommendations till you test them on yourself. Study "conditions." They affect results, and those who

neglect them will annoy patients without excuse. Learn to take in all the details of a battery switch-board at a glance. Be sure everything is right before you start the current. Always start the current at zero and with care. Keep your batteries in good order. Keep them "surgically clean." Either use electric currents properly or do not use them at all.

THE VALUE OF SKILL.

In the treatment of patients with electric currents the economy and profit of skill can never be overestimated, for with the same apparatus and the same professional standing one physician may be a "day laborer" and another an artist, and to recognize this distinction is the first glimpse into the light.

While a few clinical results are the direct action of currents employed and skill simply places the electrodes and regulates the dose, yet in by far the majority of the uses of all electric currents the best results can only be the product of an artist hand and a directing mind. The master of technique secures his results with ease, while the unskilled owner of even the finest apparatus labors in vain to secure them. He does not know how, and he soon doubts their possibility. Like a blindfolded traveler taken to a hill top in a strange country and told to delight himself with the beauties of the landscape round him, so the average physician stares at the terra-incognita(?) of scientific electro-therapeutics with the bandages of ignorance upon his eyes and sees nothing of all that research has made plain. To him electricity is electricity and nothing more. Its art, in his mind, reaches to the art of the hypodermic needle and does not go beyond it. Quality of current is nothing to him. One "battery" is the whole subject, and its cost the whole object of concern. As to technique, why, cannot any one rub a sponge-electrode over a patient! The "claims" made by "enthusiasts" in behalf of this therapeutic agent are dis-

missed as food for the credulous, while he yet cannot state of his own knowledge the first rudiments of electro-physiology.

But lift the bandage from his eyes! All the rich resources he now beholds are open to all investigators of established facts and can be employed by every physician who will learn how. Good apparatus can be purchased, but skill in its use cannot be bought. There is no royal road to dexterity with instruments. Experience alone teaches; practice alone makes perfect. Every touch of the master's hand, every pressure upon the electrode, every step in the right selection of the current and the regulation of the dose plays its part in compelling the results. The difference between skilled technique and untrained technique is as significant in the manipulation of electrodes as it is in surgery, music or golf. The novice cannot compete with the expert.

In ceasing my clinical object-lessons in the correct technique of high-efficiency electro-therapeutic practice it is my aim to provide in this book the best substitute that written words can furnish. Not only has there hitherto been no manual of this kind published in any language, but much of the instruction here given originated in my personal work and has been taught in no other school of scientific electro-therapeutics. These word-clinics are therefore an important addition to my other writings and will be found valuable in proportion as they are studied. They are designed to teach the short road to skill.

For information upon electro-physiology, electro-physics and full clinical directions covering galvanic, faradic and static methods, the reader is referred to my principal text-book, "The Treatment of Diseases by Electric Currents."

ABOUT APPARATUS.

In this manual I shall consider the technique of employing in medical practice four varieties of electric cur-

rents and their combinations—galvanic, induction coil, static and sinusoidal. As a working basis of understanding with my readers the following will be taken for granted:

1. That an efficient galvanic battery has about fifty primary cells, a rheostat, a reliable meter, an automatic interrupter, pole changer and the essential switches.

2. That a modern high-grade faradic apparatus has four or six primary cells, and contains the essential set of therapeutic coils, a rapid and slow interrupter, a pole changer, rheostats for both primary and secondary circuits and the essential switches.

3. That the reader's sinusoidal equipment is the standard apparatus.

4. That the therapeutic static machine must generate sufficient current for therapeutic work, demonstrable by tests, without regard to size, type or maker, or any other consideration than its current capacity.

The author's position in respect to apparatus has been clearly stated many times and will be repeated here. It is solely that of a physician who is interested in the development of scientific electro-therapeutics. I have neither commercial interest nor profit in any of the numerous instruments identified with my name. Every new step in advance, by whomsoever made, is welcomed by me according to its merits. The merits of any electrical apparatus of any type or size are not dependent on opinion, but are to be determined by proper *tests*. Each variety of electric current can be as fully tested as any drug. Its qualities can be definitely ascertained in an hour or so by any one who knows how. Personally, I can neither criticise nor praise a battery or an instrument that I never saw. From all quarters of the country I am questioned by physicians as to which is the best apparatus or which the best manufacturer. Such questions cannot be answered by me. With fair intent toward all reliable manufacturers and without prejudice toward

any, I teach the *principles* of electro-therapeutics and stop there.

In so far as the large increase in the number of static machines in this country has been the outcome of my "Manual of Static Electricity in X-Ray and Therapeutic Uses," as well as my earlier writings on the same subject and my clinical demonstrations of the value of the apparatus when rightly used, I am gratified to have been the means of spreading knowledge that all physicians should possess, but I do not stand sponsor for any particular machine. The *sine qua non* is the satisfactory generation of a sufficiently powerful curent. Beginning as I did with a machine which produced only a small current, and later exchanging it for a larger one, and at intervals obtaining still larger machines as the need and advantage of greater current was felt, I still crave an apparatus which, without being too inconveniently large, would yet give me twice the present maximum of current for therapeutic use. This is the end at which to aim in improving static machines. There is a limit to bulk, and it has been reached, but the limit of desirable current output is far beyond any that I have ever demonstrated.

But let me here say that large size and number of plates do not always assure an equally large current from static machines, even of the same make. I have seen some 10-plate 30-inch machines less efficient than other 6-plate 26-inch machines. I have seen three large machines of the same make stand on the same floor, receive the same care and be subject to the same conditions in use, yet one of the three could always be relied on to generate fifty per cent. more current than the others. Similar conditions and equal care never equalized the therapeutic efficiency of these machines and it is probable that the inequality of results reported by different physicians is partly explained by this fact.

But the machine or battery is only the inanimate source of current. Correct technique must direct it, and

the administration of the remedy also requires the possession of a sufficient variety of proper electrodes, and here most physicians fail. The equipment of these accessories is not less important than the equipment of batteries and office furniture. It is a pleasure to note that healthy competition is doing much to promote progress in design, quality, workmanship and construction in the mechanical field of medical electricity.

The change which has come in the scientific status of electro-therapeutics needs only now a more general leavening of the profession. When medical colleges learn to do the subject justice and graduate their classes with a sound training in the rudiments of electricity a single decade will complete the revolution.

In dealing with *technique* in this manual I shall aim to cover all the foundation essentials so that the reader who works out the tests here given will be equipped to take up any special form of treatment afterward and apply the same principles correctly. I do not expect to describe every kind of treatment that can be given with each current, but I shall teach the principles which govern all applications of every sort and the future use of them will be merely a matter of detail. To avoid some needless repetition in each chapter it will be well to study this book as a whole, rather than to restrict the study of any particular current to a single chapter, for useful hints are scattered throughout the book. Every test is practical and has a purpose. At first it will not tell its full story to the novice any more than a page of type will tell its story to the child who is just learning to read, but in time the sequence and value of these word-clinics will become apparent and take on a score of meanings as you work them out in front of your apparatus.

ELEMENTS

OF

CORRECT TECHNIQUE.

CHAPTER I.

GALVANIC STUDIES IN TECHNIQUE.

How to Acquire Practical Skill—A Series of Home-Clinics Covering All General and Local Methods, with Special Reference to all Great Factors, Pressure, Resistance and Rate of Change.—Author's Principles of Scientific Dose Regulation.—Personal Tests.—Cataphoresis.

Ques. How can the average physician acquire the practical skill of the expert specialist in treating patients with electric currents?

Ans. By practice on the lines laid down in this manual.

The two great objects in the uses of medical electricity are benefit to the patient *after* treatment and enjoyment of the patient *during* treatment. The secret of accomplishing these ends may be summed up in three words—*pressure, resistance* and *rate of change.* These factors underlie the *art of technique,* and the artist in technique is he who understands and controls them rightly.

Selection of the right current, correct regulation of the dose, mastery of technique—these mark the work of the expert and easily account for his results.

Quality of pressure and *rate of change* in the technique of local applications are fundamental with all currents, while the management of *resistances* in the circuit calls

for the most complete knowledge of electro-therapeutics and the tolerance of tissues.

The study of these primary elements in the administration of electricity is as requisite as the primary study of fluid extracts, tinctures, incompatibles, minims, drams, adjuvants, medicinal dosage and prescription writing in the administration of drugs. The knowledge of them makes electro-therapeutics a scientific part of scientific medicine; ignorance of them leaves electric currents outside the field of enlightened therapeutics altogether—conjured with by many in blind fashion, but sadly misused when crude methods are blindly aimed and true methods not even guessed at.

The need of this "manual of correct technique" will therefore be appreciated by the fifteen or twenty thousand physicians who have bought apparatus and have had no instruction whatever in the elements of the art of expert manipulation. Clinical results require skill, and skill should be acquired if it is possible to do it. It is not only possible, but is the reasonable demand of patients whose rights the physician is bound to respect or fall to the level of the quack.

I purpose therefore to show how this essential skill can be acquired—at home, in your own office—by the exercise of reasonable perseverance and as much medical knowledge as a student of modern surgery or medicine is expected to possess.

The first step in self-training is a recognition of the fact that incompetent and low grade "batteries" are not *therapeutic* instruments, and details of good technique cannot be carried out with them.

The second step is a comprehension of the not less important fact that a high-grade apparatus is only an instrument in the hands of the user and will do only what the user *knows how to make it do.*

A "battery" has no more volition than a piano. It has no brains at all. Paderewski has just sailed away

with a fortune ($170,000) made from a short concert tour in this country. His only magnet of attraction is his piano. He attracts $7,000 audiences to hear him play. He does this by performing with wonderful *technique*, and to secure this technique he works six or eight hours a day in practice. He gets his results by reason of his *skill*. The country is full of other men who could take the same piano and disperse the largest audience that Paderewski ever gathered. In a degree this question of attracting by reason of *skill* is the vital question in electro-therapeutics, for the magnet that will attract and hold patients is not your apparatus, but the results you *can make it produce*. The truth of this ought to be very plain.

We will now begin the study of galvanic technique in the following way:

1. Take two ordinary sponge-covered hand electrodes, dampen with plain water and connect them with the terminal posts of a galvanic battery. Grasp one electrode in the dry palm of each hand and increase the current slowly from zero by adding one cell at a time, or by switching in forty cells and regulating the current-strength through the rheostat. During the process observe the needle of the meter. The physician who discovers in this practical way that he can scarcely obtain five milliamperes of current with the entire voltage of forty cells will appreciate why I teach that *plain water* should *not* be used to wet galvanic electrodes.

2. Next fix the metal tips of two conducting cords at the opposite sides of a shallow crockery dish so that they are about three inches apart. Add enough water to cover the tips and switch into circuit twenty cells. Increase the current from zero till the entire voltage from twenty cells is in action and note the low reading of the meter. Leave the voltage all in and stir into the water one grain of bicarbonate of soda. Note the higher reading of the meter. Add another grain of bicarbonate

of soda, and repeat the observations till the fact is demonstrated to your satisfaction that the same galvanic voltage which will only produce a volume of five or ten miliamperes through the resistance of three inches of plain water will develop two hundred and fifty miliamperes if you add enough bicarbonate of soda to reduce the resistance and increase the conductivity. This object-lesson is of fundamental importance. Remember it.

In this experiment note the hydrogen bubbles at the negative pole. Note that the positive tip remains clean.

Substitute chloride of sodium for bicarbonate of soda and repeat the experiment. Now note the green corrosion of the positive tip (which will discolor electrodes in practice), and you have my answer to the question why I advise bicarbonate of soda in all galvanic work and why salt is not "just as good." Many use salt because they have not been taught better.

3. Now take two sponge-covered electrodes—one a flat pad and the other with a handle. To wet them properly with the least trouble have a box or bottle of powdered bicarbonate of soda at hand. Without any exact measure pour about a half-teaspoonful into the basin and draw on it a quart of water as hot as can be tolerated by the hand. Dip the electrode and press out the surplus water. For the first test press them *nearly dry.* Place the pad under your own forearm and the hand electrode on the opposite muscles. Then make the following series of observations:

a. Cut out the rheostat and rapidly switch ten, twenty, thirty and forty cells into circuit. Note the muscular and sensory disturbance and feel the objection to this method of current increase in fine work upon delicate tissue.

b. Insert the full rheostat resistance, switch in forty cells and rapidly reduce the resistance through the rheostat. Again note the unpleasant action of *rapid rates of change* in using the *constant* galvanic current.

c. Repeat the last experiment with a very slow manip-

ulation of the rheostat till full tolerance is reached. Note the comfort of slow rates of change.

d. Pause till sensory effects subside and slowly add more current by slowly decreasing the rheostat resistance till tolerance is again reached. Repeat the same step till the sensory effect does not subside, and this will represent the full dosage.

e. When the full dosage has been developed record it; reduce current to zero by restoring rheostat resistance; keep the electrodes in place; reverse the polarity by shifting the arm of the pole-changer, and at once add current till the tissues burn—stop till the chemical action which causes the burning adjusts itself (a minute with a small amperage suffices), and then raise the cur rent-strength as before. Note that a change from the positive *acid* polar action on the skin to the *alkaline* negative polar action, and *vice versa*, sets up a brief sense of heat which requires a pause in treatment till it subsides. Abrupt pole changes are uncomfortable.

f. Seek out a slight abrasion or eruption on the skin and move the electrode over it with the same dosage that was comfortable before. Note that the *hole* in the resisting surface of the skin is like a hole in a pail.

The water pours through the hole in the pail and the current pours into and through the hole in the skin. The dosage which was at first spread over, say, twenty square inches and hence was mild, is now concentrated into a small fraction of one square inch, hence its extreme density *multiplies its dosage* for the abraided spot. To comprehend the instant and sharp *bite* we must realize that it is caused by a change in dose of from perhaps one miliampere to a hundred, though the meter may show that the total dose for the whole area of the electrode is unchanged. The current runs to the point of least resistance.

g. Cover the spot with any dry piece of plaster or protecting material and now note that all the "bite" is

removed and the full current is again tolerated. This brings home to the operator the need of protecting the patient from needless suffering by covering (or avoiding) any similar spot in a situation that is being treated. Mere redness of the skin is sufficient to set up undue irritation. Especially, if liniments, counter-irritants, or plasters have been applied and the skin is not in a normal state *use care in employing the galvanic current.* Tests upon your own person will best teach *why.*

4. Now begin a second series of observations. Freshly wet both electrodes with hot bicarbonate solution and do not press them dry. Leave them as wet as possible without dripping. Repeat the seven preceding tests and note the *decrease of sensory annoyance* on your skin and the *greater* current you can develop with the same cells and the same methods. This object-lesson will teach that merely damp electrodes do not suffice for skilled work with the constant galvanic current and that sufficient saturation is necessary. The covering of the electrode must be *hot*, *wet* and *alkaline.*

5. Next attempt to sweep the hand electrode up and down over the surface of the forearm after the manner of a labile application. Note that it does not *slip easily* and tends to *pull* when moved with pressure upon the hairy side of the arm. Now rub a cake of fine soap over the sponge of the electrode till a little hot, wet lather is produced, and repeat the same labile test upon your arm. The electrode now glides easily over the surface and another important effect will be observed. The current is *felt to be more comfortable*; its sharpness is diminished, and if a higher dosage is desired it is better tolerated. Therefore, I teach *soap both electrodes* when *labile* work in technique is to be demonstrated.

6. The kind of soap to use is important. It must possess two qualities; it must hold its lather long and have a non-irritating alkalinity. Ivory, bath and laundry soaps are much too alkaline, and when often used are

annoying to tender skins. Castile soap dries too quickly. The best shaving soaps hold lather well, and I have also found the clear, white "surgical soap" now for sale by druggists to be very satisfactory. Remember that the two functions of soap so used upon electrodes are *emolient* and *lubricating.*

7. There is one other important use of soap in electrotherapeutics to which I shall refer here—*cleanliness.* Selected sponges possess qualities which make them ideal for labile work and "felt" is also a necessity. Can sponges and "felt" be kept clean, deodorized and aseptic? I teach that *they can be kept clean until worn out by continuous use,* and with no more trouble than a few rubs and a squeeze.

My usual clinical demonstration was as follows: Take any sponge, rub it on the wet skin of a dirty dispensary patient, and place it where decomposition will be favored. When it smells badly take it to the wash basin, dip it in hot water, dust on it q. s. of the powdered 5 per cent. formaldic soap I use, and squeeze it in and out of the water till well lathered; rinse clean and it is ready for use—smelling again as sweet as an ocean breeze. In this way I have deodorized a foul sponge in twenty seconds as a clinical demonstration, but in my own private practice no sponge or any covered electrode is allowed to become foul. Cleanse them at once after each use upon patients and they are then always ready.

This *indispensable* formaldic soap has been a source of great comfort to me during the two years I have already used it. It is supplied by the maker in small tin boxes with perforated tops and at a reasonable price per dozen. It should be sold by all dealers in electrical apparatus.

8. At this point it would be well to test the various materials that have been advised for covering electrodes. You will soon discover that absorbent cotton, chamois skin, "punk," flannel, felt, clay and numerous other substances recommended will not answer for *labile* applica-

tions. Learn also by actual tests how important is *proper thickness* in the cover of a galvanic electrode. Thin covering has burnt and tortured many patients who need never have been hurt at all.

9. The next step in the study of technique is the study of *pressure upon the active electrode* whether it is maneuvred by the operator or held in place by the patient, or by sand bags. The study of *varying pressures* with all currents has been an original part of my instruction, and I am not aware that any other clinic than my own has demonstrated its importance. It is one of the fine points of technique in which the master shows his superiority over the tyro, and its relation to therapeutic results and to the satisfaction of the patient is closely identified with the scientific regulation of the dose.

Firm contact will, as a rule, be made at the stabile, or so-called dispersing, electrode without any special attention, as the weight of the body resting on it, or the weight of a shot, or sand, bag, or the firm pressure of the patient's hands, will hold it in place while the two hands of the physician are occupied—one with the switchboard and the other with the management of the electrode.

Pressure in practical technique has two qualities—*steadiness* and *weight*. An uneven pressure will affect the *results* when these depend, as they often do, upon the combined details of the technique. Too light pressure alters the *degree* and *depth* of current action, and pressure that is to heavy will tax the operator's hand or arm, or needlessly impose a burden on the patient.

10. With the constant galvanic current test upon yourself all variations in pressure, from mere contact of the electrode to an amount beyond comfort, with wide variations in dose, upon different parts of the body, and with labile and stabile applications. Especially note alterations in effects with different pressures upon the forehead, vertex, upper and lower spine, parts well covered with muscle-masses and parts thinly covered. The *object*

of treatment governs the proper amount of *pressure* in a given case. It takes into account the amperage of the current, the movement of the electrode, the part treated and the action desired. It cannot be a routine. It is an essential element of the entire dose regulation, and is the instinctive selection of expert experience. It is always important about the head, and upon the spine it is particularly important; in seeking relief from *pain* it is one of the chief details of technique, and even in the coarser *tonic* applications upon groups of muscles it constitutes much of the difference between the "artist" and the "day laborer."

11. To illustrate: In a case of extreme soreness of the scalp in the region of the right occipital protuberance, in a patient with epithelioma of the tongue, I prepared and placed electrodes and adjusted the dose. Being called to another part of the room I left the active electrode in the hands of a student who was not only a trained physician but who had previously received a full course of electro-therapeutic instruction in this city. When I returned the patient was nervous and anxious. He was eager for *me* to again hold the electrode, and explained the difference in the relief afforded him by my *even, firm, supported pressure* upon the right spot, and the less satisfactory results of the *uneven pressure* of the student who let the electrode shift slightly off the center of soreness and varied the firmness of his grip. He also tilted the electrode so that it was not always flat, and pressed it against the occiput without supporting the patient's forehead, thus taxing the patient's neck. All these points were developed as part of the clinical instruction and their relation to results made plain. Therapeutic action of all currents is retarded by faulty pressures, and the patient may be made unhappy while the doctor wonders why?

In cases of *spinal galvanization* I have demonstrated the varying dosage from nape to sacrum, with the pressure

and sweep of movement up and down the spine and across the lumbar region, essential to produce *tonic* and *refreshing effects.* Then passing the labile electrode to a physician to continue the seance the patient remarked that she was made "fidgety and tired" by the same current, same dosage, same electrode and all but the same *hand* as before.

Again taking the electrode in my own hand I have again demonstrated the pressure and movement that once more refreshed and gratified her. Proper treatment she "enjoyed"; the other was neither pleasant nor half as beneficial—facts brought out in many cases by repeated tests and inquiries. Upon the arms of writer's-cramp cases I have made many similar demonstrations. Over and over again patients declare that if they were blindfolded they could detect the first touch of *my* hand upon the electrode and no one else could deceive them. It has been my custom to demonstrate this test by having patients close their eyes while my students have witnessed the importance of *skilled and even pressure.*

The same element of intuitively directed pressure is especially important when the physician is applying either a constant or interrupted galvanic or high-frequency sinusoidal current, by the author's method, to the *perineum.* The muscles which need to be benefitted are in different layers and the skin of this part is complicated by the resistance of the hair and the proximity of the spincter ani. An educated hand and well-regulated dosage will gratify the patient; a hand with no attempt at self-training will do little good and may greatly annoy.

By clinical tests; by observing the efforts of students; by contrasting the results of many treatments similar in all respects save *quality of pressure* upon the active electrode the conclusion is unavoidable that the study of varying degrees of pressure should be one of the chief details in home training in correct technique. There is

but one detail of manual manipulation more important, to wit: *rate of change.*

12. In the chapter on "Pain" in my "Treatment of Disease by Electric Currents" I refer to the effects of *rate of change in the current* and the relation of this *rate* to the *energy of current action.* What I here say is, however, apart from *intrinsic current-strength* and relates only to the *labile electrode*, i. e., the rate at which the operator changes its situation upon the tissues of the patient. Without educated skill in this essential factor of technique there is no real skill at all.

In a general way applications are said to be *labile* or *stabile*, but in many administrations the stability is *relative*, and more or less change of position of the electrode is required during treatment. How this should be managed to meet indications is a study of rudimentary therapeutics.

13. Make the following tests: With the constant galvanic current, positive pole, dosage 4 mil., move the labile electrode *quickly* across the forehead and over each temporal region. Repeat a little *slower.* Repeat at *half rate.* Repeat at *quarter rate.* Repeat so slowly that the full sweep consumes about one minute. Repeat again, consuming two minutes. Observe the different impressions made upon the tissues and special nerves by the different *rates of change* with an *unchanged* current-*strength.*

Make similar tests upon a case of diffused frontal pain. Also upon a case of neurasthenia; also anemia, and contrast the tolerance of the latter with a case of hyperæmia.

Record the variable effects in tests on your own tissues, and make all patients an educating source of information by questioning them on every point. No two cases are exactly alike, and certain types are very wide apart. The technique cannot be a routine, or repeated as a parrot repeats a sentence, but must be adapted by experienced judgment to the needs of every case in hand.

14. Now take the spine and muscles of the back. Regu-

late the dosage to nearly full tolerance and test the impressions produced by rates from very slow to very rapid. Study the rate which is *sedative*, the rate *tonic*, the rate *stimulating*, the rate *anodyne*, the rate *muscle-contracting*, the rate *refreshing* and *pleasant*, the rate *disagreeable*—and, finally, hold the electrode *still* for say five minutes in different situations and note all the shades and complexities of effect that depend upon the *knack of the artist hand* far more than upon the cost of the battery. Studiously strive to master the *proper management of the hand* in all electrotherapeutic operations. In going up and down the spine observe the comfort with which a quick movement of the electrode will glide the current past a troublesome small eruption, while lingering on the same spot would make the patient flinch as from a burn.

Note the ease with which 20, 25, 30 miliamperes are tolerated on normal skin between the lower cervical vertebræ and the sacrum, creating a sense of warmth, glow, refreshment and tonic effects which are invaluable in neurasthenias; and note also that 20 mil., or even 10 mil., and often but 5 mil. will tease, bite and burn the same patient in the most irritating manner at another time if the skin then reflects some disturbance of digestion or approaches the state which a rubefacient causes. Then treatment must be deferred till the skin heals, for not even skill in technique nor adjustment of the rate of change to perfection can make the positive galvanic current an ideal sedative and agreeable tonic through an epidermis that has holes in its epithelium.

15. Now take (1) a normal arm, (2) an arm with increased excitability and (3) an arm with diminished reaction to the galvanic current, and change to the negative pole, 15 mil. The labile electrode must be well soaped. Begin on the flexor surface and move the electrode very slowly from the wrist toward the axilla. Observe that as the motor points *creep* under the electrode no sudden start rouses the muscles into action. Now fol-

lows one of the prettiest studies of *rate of change* that can be made. Over the flexor motor points of the forearm and next over the inner surface of the arm, sweep the electrode with firm pressure and a graduated increase of speed. It should be done with the free wrist movement that practice alone gives the master of this technique.

At first the muscles only *stir*; they can be seen to move with greater and greater energy as the same current that before crept upon a motor point and left it slowly now rushes at it with more startling suddenness and begins to produce the *make and break* effect of an *interrupted* current. *Intensity* of muscle-jump keeps pace with *quickness* of electrode movement, and under the arm upon the median and ulnar nerves where the skin is thin the *constant* galvanic current can be made to set up as violent a contraction as if a powerful intermittent faradic current was at work. The *flexibility and control of the operator's hand* gives great range to the degree and kind of contractions within the scope of an *unchanged dosage*, while the dosage itself can also be modified to suit the ascertained reactions of each patient.

In the three arms just compared, the different intensities of contraction that will be made by the same 15 mil. afford a study of special value hereafter in regulating current-strength to produce desired therapeutic effects. You can see the effect as you make the tests, can record the dosage that produced it, and can form a general idea of what is normal and abnormal in reactions.

Later I shall teach how to determine the therapeutic values of different grades of muscle contractions, and how dosage is regulated by the operator with scientific precision without a single question to the patient.

One of the points often noted by my pupils is the fact that I adjust current-strength to definite dosage for definite effects with all currents, and rarely ask the patient anything about it. The properly taught physician

can become a better judge than the patient, but at present we must continue the study of labile technique.

16. Now hold the electrode upon a part and slowly *coax* up the positive galvanic current till the skin protests against more. Wait one minute. Then advance the meter needle till the current again burns and bites to the limit of tolerance. Then wait till sensation is comforted. Now assume that the part is the seat of a congestion or pain, which it is the intent of treatment to relieve. Assume that your electrode covers but a quarter of the part. Obviously here is primarily a *stabile* application, which must become labile enough to enable the current to act in turn upon the entire area that needs it. The electrode, therefore, must be *moved*. At what *rate* shall it be moved to produce the best effect with the least discomfort? Far more forcible than my text will be the object-lesson of trial upon your own tissues. First move the electrode *quickly* off the tissues in which tolerance has been developed by *slow* adjustment of the chemical reactions in the skin. It will at once rest on parts in which no slow chemical adjustment has taken place, and the sudden changes that seek to create an equilibrium will be felt as a semi-burn. It is not a *rate of change* that will be relished by the average patient.

17. Next try reducing the dose one-half, then shift the electrode to an untouched spot and build up the dosage as before. This is a way that is sometimes needed, but is not my preference in average cases. Now test what is usually the most effective and is always the simplest way if the state of the adjacent skin is not opposed to it. Hold the electrode still, as first described, until the mind of the operator, projected into the tissues, recognizes as the skilled operator can, that the desired action has been set up beneath the contact. The dosage is now established and remains unchanged. With a neat and almost imperceptible twisting and *firm pressure* the electrode is slowly maneuvred over the affected part. It creeps upon

the new tissues with tentative caution, allowing the threatened irritation to subside before it advances half an inch. Its movement is patient but persistent; a siege, not a rushing attack. The total time involved in treatment is about the same as by any other method, but it is more workmanlike and productive of better results than any other method may be.

18. Remember the rule of tolerance, that on a reddened skin a small amperage tends to "bite" sharply and feel hot, while on a pale skin the same amperage may not be felt at all. This rule applies to all currents-galvanic, induction coil, sinusoidal and static. But remember that the superficial sensation of the patient is not the guide to deep therapeutic action in the majority of cases treated by the constant galvanic current.

19. We have so far considered only the *constant* galvanic current. Let us now study the *interrupted* galvanic current. Its main uses employ slow rates of *make* and *break*, which are secured by the adjustable automatic rheotome. A battery without this rheotome is incomplete. It provides a current which is among the most important of interrupted currents, and is often indispensable. Its great field of work is muscular, for the galvanic current lays aside its electrolytic action when its constant flow is interrupted.

20. In setting up muscular contractions for curative purposes a knowledge of correct dosage is necessary, and I shall now teach it.

Never ask your patient if the current is "strong enough," and never oblige a patient to complain that you have made the current "too strong" when you are employing interrupted currents to contract muscles. The physician is a better anatomist than the patient; he is a better clinician, and he should know better the physiology of muscle fibres and the results he wishes to accomplish. *Dose regulation is, with me, a matter of precise, scientific accuracy, adjustable to all conditions and ages, from*

babyhood to senility, without asking the patient a single question.

Patients soon recognize that I know better than they could tell me when the dosage is "just right," and physicians attending my clinics for instruction have noted with surprise that in almost the entire therapeutic range of all currents I seldom make any inquiries on which to base dose regulation. The proper *principles* should be taught in all clinics, but so far I have never learned that they were taught anywhere outside of my personal demonstrations. The formulation of the principle has been mine.

The sense of *touch*, the sense of *hearing* and the sense of *sight* are the *guides* to the adjustment of all currents to produce indicated therapeutic actions, with the exception of a few varieties of technique for special purposes. In the above statement all devices connected with batteries are considered elementary, and the skill of the operator who is properly trained can alone employ them with exclusion of guess-work and with the accuracy of scientific principles. The galvanic current is continuous, unless the circuit is broken. A complete switchboard has, as I have said, an automatic interrupter to break the circuit at rates desired by the physician. The simple clockwork rheotome is not perfect, but gives me the most satisfaction and the least trouble. By shifting a sliding ball the pendulum of it can be made to swing slowly—about 100 periods per minute—or at faster rates up to 500, or 600, or more per minute.

The *interrupted* galvanic current has many uses, and from the surprised remarks of some of my students who have not only used a galvanic battery for years, but have had considerable electro-therapeutic instruction elsewhere, I judge that the importance of it is nearly unknown to the majority of medical practitioners. Make the following tests :

21. Bare one arm to the shoulder, rest any part of the

forearm upon the positive pad electrode, and connect a medium-sized hand electrode to the negative terminal. Both these electrodes are to be prepared according to my special directions, which cannot be repeated in every chapter. The lubrication with soap must not be forgotten.

Now adjust the switchboard to give the *interrupted* current, throw in 30, 40 or 50 cells, raise the rheostat to zero, and start the pendulum with the ball at the bottom. Then in turn pressing the hand electrode upon the different flexor and extensor motor-points of the hand, forearm and arm, test every gradation of current-strength and every variation in the rate of change, i. e., the *rapidity* of the *interruption*. With the slowest rate, first cautiously increase the current from zero until the muscle faintly stirs. Look at it, feel of it, add a little more current and note the added action of the muscle fibres. Now train the eye to see and remember, and the fingers of the hand holding the electrode to recognize and never forget, each definite response of muscle fibres to each definite accession of current-strength.

The contraction begins as a gentle wave of motion. It *lifts* more and more beneath the electrode and affects a greater stretch of fibres as the energy of the current is increased. You note that it is now vigorous enough to act as a *stimulus to circulation*, but under-works the muscles if the object aimed at was to be the invigoration of quick, sharp exercise.

With more current the muscle contracts and relaxes with a greater rise and fall, and takes on the peculiar *elastic* quality which is the evidence of correct dosage for the purpose of tonic exercise.

The range of *movement* of the fibres shows the *extent of the exercise*, and the *elasticity* proves the contractions to be within the normal limit of endurance.

There is no pain about it, and it is refreshing to an arm that was tired before treatment. It is the exact dose

regulation for this definite purpose, and being independent of the advice of the patient is as applicable to an infant as an adult. The trained eye can see it, and the trained sense of touch will always recognize this *maximum elastic quality* in the contractions of any group of muscles in the body. The *principle* applies to all muscles and all currents and only fails as a guide when complete paralysis prevents response to the current.

22. Now increase the dosage a little and note that what was *refreshing* before is presently creating *fatigue*. As the current increases see and feel how the *blow* of the interruption now *strikes as on a board*. The fibres thump. The sharp jerk of the muscles has no sense of *elasticity* left. Tolerance and endurance are being *exceeded*, and soon the immediate discomfort will give place to complaints of pain and *exhaustion*. Is it not simple?

But do not leave the current at the *thumping* point. Cut it down till you again feel the *resilience* that suggests rubber, or a fall upon a spring mattress rather than a fall upon a stone pavement. Then begin to test the difference between your comfort with this restful and refreshing current with its *slow* rate of interruption, which permits the muscle fibres to relax after each contraction and rates of two, three, four and five times the speed, which give the fibres less and less time to relax and renew their energy.

As "all work and no play makes Jack a dull boy," so a rate of interruption which makes the muscles contract (work) two-thirds, three-fourths, four-fifths of the time, and finally all the time, and *leaves no space for the indispensable rest* which complete relaxation affords, *exhausts* the vitality of the muscles in proportion to the disturbance of the normal relation between work and rest. Therefore with rapid rates you must adjust the dosage to tolerance on the same principle as before.

23. Note also another point. You can run a hundred yards at a rate you could not run for a mile; you can

sustain a weight for a minute that you could not hold up all day. Therefore, test how tissues can tolerate, and benefit by a short, sharp, *excess of current, quickly reduced and momentarily advanced*, and you have the philosophy of the value of the "swelling" method which is so often a neat resource of skilled technique. Practice this important method and learn the proper limits to its rise and fall of dosage.

Test every possible variation of dosage with the interrupted galvanic current on all the muscles. Test both on yourself and on intelligent patients, who can reply to your requests for information during the period when you are acquiring skill.

24. While the miliampere-meter will not register anything but the *constant* galvanic current and is useless as a measure of the interrupted galvanic current, yet you can easily make comparisons in the following practical way: With the electrodes in position increase the constant current to any desired point, say 10 mil. Then, leaving all other switches and the rheostat unchanged, switch in the interrupter and note the degree of contraction which is obtained by this equivalent of 10 mil. The *needle* will fall to about zero, but *the same amount of current* is at work. Test 15, 20 and 30 mil. in the same way. Or, after selecting the dosage, you can simply remove one cord tip from the terminal post and *make and break* the contact by hand a few times for this test.

25. After teaching yourself all that can be learned about the relation of current-strength to *energy of contraction* with the *negative* pole repeat the same with the *positive* pole. A very few experiments will demonstrate the reason of the universal rule (applicable to all interrupted currents) that the active electrode should be connected with the negative pole when the purpose of treatment is the contraction of muscle fibres.

26. Next note that whether you *break* the galvanic current by hand or by the clock-work rheotome, the cur-

rent makes its contraction and *lets go* at once, even though by hand you still hold the cord tip on the terminal. There is no tetanus or cramping grasp of the muscles, such as you obtain with faradic, sinusoidal and Leyden jar currents. This is simply owing to the character and rate of the interruption. The requirements for tetanizing contractions are interruptions *acting so rapidly* that the muscle fibres cannot relax between the succession of blows that stimulate the function of contraction. The galvanic current will act in the same manner *if the conditions are fulfilled*, as I demonstrate easily by increasing the rate of interruption beyond that ordinarily used. This is done by hand by an expert in technique.

Nearly all uses of the interrupted galvanic current relate to moderate or slow rates of interruption *for the reason* that the apparatus is constructed with this limitation.

27. It is important to test the differences in *quality* and *quantity* of contractions furnished by the interrupted galvanic current as compared with slowly interrupted coil currents and the static current. To do this repeat the same technique with each form of current on your own arm.

Note the *broader lift* of the *greater* galvanic *amperage* and thus understand why *it acts on more fibres at a time* and will often set up contractions in cases of paralysis, which will not respond to the common faradic battery. Contrast and study these qualities of the different currents so that you can instinctively select the one best indicated when you confront the problems of actual practice.

28. Passing now from the subject of muscular contractions, let us again turn to the constant current. About the *head* the further study of *rate of change* in the current is important. Also the location of the non-active electrode. Also the direction of conduction, whether along or across nerve paths.

Pass a small current transversely through the temporal

regions and gradually increase it from zero until you have learned enough. Also pass a current across from one ear to the other, and from one pneumogastric in the neck to the other. Tests of varying dosage will do much to eliminate all such procedures from your future treatment of patients.

29. Now make firm contact upon the abdomen with a large pad, negative, electrode. A bandage will hold it in place and release your hands. Press a positive electrode upon your vertex and test the sensations and taste set up as the current slowly rises from 2 to 3, 5, 7, or 10 or more miliamperes. Experience the peculiar crushing sense of *weight* upon the vertex that develops as the current passes tolerance. This tolerance varies in different persons and depends somewhat upon the amount of hair, but in your own case carry the dose up to and beyond tolerance so that you will afterwards appreciate what it means to a patient if you neglect the proper precautions. Test also rapid and slow changes in the amperage.

If your hair is thick, note that little current gets through until it has been wet by the moisture of the electrode. If the hair is thick the application to the vertex is essentially stabile, but if the head is bald or the hair is thin then any desired movement can be imparted to the electrode without inhibiting the dosage.

30. Next change the positive electrode to a small sponge-covered ear bulb and study the very particular and slow rates of change in amperage required to avoid vertigo in treating this part. The limit of dosage may be 3, 5 or 6 mil., but if you test both poles in the ear and alter the rheostat so that the maximum dosage is developed and reduced at various rates you will learn the important fact that the vertigo is not caused by the *quantity* of current, but by *disturbance of its equilibrium*. A patient may be made as dizzy by your suddenly cutting out the last half miliampere at the close of treatment as by your

increasing the current half a miliampere past tolerance at the beginning of treatment.

31. The uses of the constant galvanic current in the ear are few but important, and correct technique is vital to using it at all. Remember the following rules:

a. Use all precautions to reduce resistance.

b. Place the non-active electrode under the forearm just above the wrist, or on any convenient part not in a *transverse* direction from the ear undergoing treatment.

c. Begin at zero and cause the current to creep at an even and snail's pace from zero towards the desired dosage.

d. At the first report of faintness stop moving the current till disturbance ceases.

e. An increase of one miliampere per minute and decrease at the same rate is not too slow for correct technique, and slower may be required in special cases.

f. It is as important to reduce current very slowly as to increase it very slowly.

g. Do not break the contact or the current during the seance.

Practice tests which will impress these points on your mind for the benefit of your patients.

32. Retaining the pad electrode on the abdomen next change the small ear electrode to a labile hand electrode, size 2x3, and make tests of dosage, polarity and rate of change, upon the sides of the neck from the ear to the clavicle along the border of the sterno-cleido-mastoid. Here, again, nausea and vertigo can be caused by improper technique and dosage, and the physician should practice on himself until he knows what he is doing.

Here, also, friction from a starched collar, or conditions of various kinds, may affect the skin so that tenderness is abnormal. Learn to know normal conditions and all others will then be recognized and can be managed accordingly.

33. Next test local and stabile applications to the eye.

Tolerance, dosage, effects of different rates of change, reversals and mild and slow interruptions are the points to study.

34. Next test a series of water-bath applications to the arms, hands and feet, with both constant and interrupted galvanic currents. Note, with the hands in water to above the wrists, how the positive pole bites more than the negative; how a red line of demarkation burns at the edge of the water if you do not know how to avoid it; and how intolerable a quick reversal of poles with the full current is felt to be.

As both your hands are in the jars of water an assistant will be required to move the rheostat as you direct, but you should watch the meter and carefully note the effect of every alteration of the dose.

A pair of the author's "sinkers" are very convenient to connect with the battery posts and drop into the jars to make the circuit. These "sinkers," devised by me some years ago, are as indispensable in my work as a pair of conducting cords.

Now test different depths of immersion with either hand. Prick a finger with a pin and see the trouble it makes and learn to inspect every part that you may hereafter attempt to treat in a water-bath electrode.

Also vary the amount of water in either jar so as to learn how to equalize action at both poles when this is desired, and how to make one active and the other "indifferent." Test also the dose gradations upon the same area of contact and the same dosage upon different areas of contact.

35. Make foot-bath tests in the same way. Also take two equal cups, or tumblers, and fill them three-quarters full with warm water. Make them into electrodes by the aid of my "sinkers" and connect them with the battery terminals. Stand them side by side and immerse the thumb in one and two fingers in the other. Test dosage

and rates of change. Add bicarbonate of soda to the water and repeat the tests. In gouty finger joints similar methods are useful. I make great use of water as a means of contact with irregular surfaces, and nothing else can cover certain parts with equal satisfaction. This is especially true of the male sexual organs. It is true of the hands and feet. The nasal mucous membrane can best be reached by water, and the softness of the contact of water is unapproachable.

So far these water-bath tests have been made with the constant form of current, but familiarity with the interrupted current is equally important.

Return to the jars in which the hands were first immersed and tests as follows: With the interrupter adjusted to 100 periods per minute and equal contact with both hands increase the dosage until the muscles stir. Note at which *pole* the beginnings of muscular contraction are first felt. As the current is advanced in strength observe how much greater contractions occur at the negative pole than at the positive pole. Observe also that to affect both hands in the jars the current must traverse both entire arms and cross the spinal nerve centers, a fact of great clinical moment in certain cases.

37. Now note that if but one hand or arm requires this technique the other is made to work also. If you wish to set up strong contractions in your right arm you cannot raise the dose within the tolerance of your left arm if the right is in the positive jar. This teaches the selection of polarity for the active electrode. But there is still more to learn. Fix the current at full tolerance for the right arm after changing the polarity to negative and note that the left arm muscles are still contracting vigorously. To serve the mere purpose of completing the circuit they should be worked no more than is necessary. How can this be done?

Have an assistant gradually pour more water into the "indifferent" jar and note the result as the area of contact

is enlarged. If the jar is high enough to raise the water half-way to the elbow the reduced density of current now reduces the work of the muscles of this arm so that the purpose of contact is served without the fatigue or discomfort of unnecessary work.

38. Having learned how to make one jar act as an indifferent electrode proceed to make a series of useful tests in the other.

Plunge the "active" hand to the bottom of the jar and adjust the dosage to produce mild full-arm contractions. Gradually draw out the hand and note the rise in intensity of *thump* as the water falls below the wrist. Withdraw half the hand; then the thumb; then, one by one, lift out the fingers. There will be a limit to the comfort of doing this, but you cannot learn in a better way or more conclusively some of the great principles of electrical action.

39. Now reverse the test. Immerse only the index finger at the beginning. Find the dose of tolerance and then dip in two fingers. Note how the doubled contact divides the current and the contractions. Let the whole hand drop back into the water and note as it is again covered how little action upon the muscles is now caused by the same dosage of current-strength that measured the full tolerance of one finger. Test how large an increase of current is required to reach full tolerance with the larger contact.

40. Now come important refinements in technique. Raise the dose from zero and closely study the *quality* of each contraction as the current develops incipient action, mild elastic action, full elastic action, non-elastic over-action, and finally strikes the muscles the tense, hard blow that hurts. Here is a rich field of research. Make the most of it. Test all rates of the interrupter. Study all possible variations of the dose. Keep your mind on the physiology of muscles and on the physiology of the circulation while testing the degrees of action that are

below the exhaustion of over-action and you will arrive at exact results in practice when untaught operators fail.

41. Now deeply immerse the hand and increase the current from zero. When maximum contractions occur in the forearm with the muscles free, shut the fist and make increasing tension in the hand. Note how the center of local contraction immediately changes and passes further up the arm. Alternately open and close the fist and note the alterations in effect. Now twist the forearm in various ways. As you thus alter the relation of muscle groups to each other the current also acts upon them in an altered relation and the study of what ingenuity can do in this respect is one of the most important object lessons in local work upon the tissues. Rotate the arm slowly in both directions. Flex and extend the hand. Open and close the fingers. Separate the fingers. Twist the hand so that the thumb side and the little finger side are alternately out of the water.

A hundred variations can be made, all full of interest and clinical value. A few moments' attention should be given while making these tests to the convenient sitting of the patient and arrangement of the jars, so that the shoulder and back muscles will not tire during treatment.

It would take many pages to describe in full the different actions that can be studied in water-bath electrodes, but the outline of tests here given will suffice to start the reader on his road to skill. If performed with care and renewed study of physiology the benefit will be increased.

42. Passing from these tests with water contacts, take up the study of dose regulation through large electrodes in *stabile* work upon the trunk of the body. In the recumbent position place a pad electrode 8x12 under the lumbar spine and a similar pad on the abdomen. Run the whole gamut of rates of change with the constant current and then test all degrees of dosage with the interrupted current. The spinal electrode can next be shifted to other levels for repeated tests. In gynecology,

and in many cases in general practice, this is a most important form of technique and should be thoroughly mastered.

43. While the large electrode is under the spine also take a small hand electrode and with the interrupted current practice contracting the abdominal muscles and influencing peristalsis of the intestinal tract. In future cases of constipation this practice will be found useful. By this time your experimental faculty will be sufficiently developed to practice whatever may become necessary in any line of galvanic therapeutics.

44. We have spoken so far only of covered electrodes. The galvanic current is also employed with bare metal electrodes and then chiefly by stabile applications upon or within moist tissues and not on the dry skin. It is well, however, to know how it feels to hold a bare metal electrode upon the dry skin of any part of the body, and a test can be made with either pole. Before the burning sensation passes into an actual burn reduce the current and remove the electrode. Probably a single test of this kind will teach the physician enough to inspire him with care for the future protection of his patients. Remember that galvanic burns heal slowly and it is best to avoid them.

45. Needle punctures can also be tested on your own person. A small wart can usually be found somewhere on the body and affords a superior home-clinic for negative electrolysis. But how to avoid the hot, burning pain at the needle? Why, the principle is the same that I have been teaching all along the use of galvanic electrodes. Dry resistances and friction mean heat. Saturate the part with alkaline hot water and the friction of the current will be less and the comfort more.

46. The study of the effects of *dry resistances* and the contra-effects of alkaline saturation form one of the basic and most important branches of scientific electro-therapeutic research. It is a branch to which I have devoted

a great deal of attention. No one can know too much about the management of *resistance* in electric circuits, and nine-tenths of the suffering which is needlessly caused patients by untaught operators is due to their lack of information on this one point.

I have never in all my experience caused a single burn of the skin in the slightest degree with the galvanic or any other current, but patients have come to me from other physicians bearing scars and ulcers that all friends of electro-therapeutics must grieve to see. Learn to avoid them as easily as you long ago learned to avoid burning patients with local applications of heat.

A few tests with bare metal upon the skin will also impress you with the importance of *thickness* in the covering of ordinary electrodes.

47. *Iodine Cataphoresis.*—To test the question which galvanic pole drives iodine into the tissues and to impress the answer upon the mind, take a shallow crockery dish four inches wide, pour in an inch of plain water, add a half-teaspoonful of powdered raw starch, stir till it is dissolved and add a dram of ten per cent. K. I. solution. Into this white, opaque, fluid place the metal tips of two conducting cords from the galvanic terminals so that they are about three inches apart.

Pass 20 mil. of constant current. Watch the action at each tip in a good light. Observe the commencing evolution of dark iodine at one tip. Which one? Look at the switchboard and record the answer.

Note how far from the tip the iodine drifts and observe the opposite tip. Now reverse the poles and note the change that occurs. Wait five minutes and fix in your mind which pole pushes away the iodine and would therefore carry it into tissues if required.

Next repeat the test for evolution of free iodine from K. I. solution with 5, 10, 15, 20, 30, 40 mil., so that you will educate your judgment as to the proper dosage for efficient action in therapeutic practice.

48. *Cupric Cataphoresis.*—Boil an egg hard; shell it. Also procure a "chunk" of lean raw beef as large as your fist. Connect two conducting cords to the galvanic terminals and to each tip of the free end attach a piece of stiff copper wire three inches long.

Brighten each piece with fine emery paper and plunge both wires a half-inch apart through the middle of the egg. Pass 40 mil. for five minutes and observe the external appearance at each pole. See the dilating, softening action at the negative. Touch the negative wire and gently twist it. See how free it is. Now do the same with the positive wire and note that it is firmly attached to the substance of the egg.

Leave both wires *in situ*, cut off the current and with a knife cut through the egg so as to expose each wire. Study the opposite manifestations of electrolytic action. Observe how much of the green oxychloride of copper was produced by the dosage employed and see how far it has been diffused from the wire into the egg.

Repeat the test with varying current-strength so that the picture of the action and the dose required to produce it will be impressed permanently upon the mind. Repeat a test also with *tarnished* wires so that the reason why it is necessary to always brighten copper electrodes before use will be clear.

Observe that the *positive* current alone attacks the *copper*. *Both* poles affect the *tissues*. If you have any lingering uncertainty as to the electrolytic action of faradic, static or sinusoidal currents, test them in the same way and no further doubt will remain.

Interrupted currents of all kinds—even the interrupted galvanic—lose the continuous chemical action which alone produces electrolysis.

Now plunge the same wires, freshly cleaned, into the chunk of meat and study by separate tests the amount of time and the number of mil. required to actively deposit the copper around the electrode and to make it ad-

here. Practice how to loosen it by reversing the polarity. Refer to the physiological action of the galvanic current and demonstrate as many of these actions as possible, observing the differences between the negative and positive pole.

Leave the positive needle in place and shift the negative wire to a part of the meat two inches away. Insert all the cells of your battery and cut out resistence by the rheostat until the maximum amperage is registered. Then gradually push the negative wire nearer and nearer to the positive until they are finally but a quarter of an inch apart. Note the changes in the reading of the meter during this test and learn from it how great a difference in the dosage can be made by reducing the resistance between the electrodes without increasing the number of cells employed.

Note also the gentle chemical action with a small dosage, the "caustic" effects of higher amperage, and keep on increasing the current and observing the action till at last a "cautery" effect is obtained.

Study of these things will aid you to comprehend the requirements of correct technique for different effects in the treatment of patients, but the full action of each degree of current intensity upon living tissues with sentient nerves and *circulating blood* can only be faintly shadowed in these experiments. Still a sure foundation of understanding and skill can be laid.

Another feature of cupric electrolysis requiring study is the relation of time, dosage and movement to the adhesion of the electrode to the tissues. A very slow *movement* of the electrode will prevent adhesion when it should be avoided, but a little too quick motion will also prevent the deposit of nascent metal on which the therapeutic effect depends.

If you have now any question in your mind as to why metallic electrolysis is used only with the positive pole of the constant galvanic current, only upon mucous sur-

faces, never upon normal skin, and why it is not repeated at short intervals, you can best work out the answer by a few practical tests, for answers so obtained are not easily forgotten.

The necessity for a local anæsthetic to reduce the pain of the application will also be apparent to any physician who will make the test upon his own conjunctiva or membrane of the nose. The uterus is not sensitive and pelvic applications cause no pain.

I have taken cupric electrolysis as the type of all metallic cataphoresis, but zinc, silver, mercury and a number of other metals have been occasionally employed. You can buy sets of all the regular electrodes and test them in the same way. The clinical uses and merits of this form of galvanic action are set forth at length in my work on the "Treatment of Disease by Electric Currents" and should be especially studied in relation to *catarrhal inflammations* and uterine hemorrhage.

49. *Cocaine Cataphoresis.* Another detail of technique is involved in cataphoresis for *local anæsthesia.* How much current is required? How long does it take? Is the anæsthesia satisfactory for short, minor operations? Is the method adapted to extensive application? How is it superior to a hypodermic injection of the same solution for the same purpose?

The best answer to these questions can be obtained by personal experiments in your own office. Wet a pad electrode as large as the palm, connect it with the negative pole of the galvanic switchboard and place it before you on a small table. Roll up the sleeve of one arm and rest the dorsum of the arm on the electrode with firm pressure. Now take the special cataphoric electrode made by all dealers and cut a disc of white blotting paper to fit. Insert the disc in place, pour on it a few drops of a twenty per cent. aqueous solution of guaiacocaine and press the electrode on any convenient part of the forearm where the skin is normal and thin.

Connect this electrode with the positive pole, switch forty cells into circuit and *at once* adjust the dose to 20 mil., which is about the necessary strength with the size electrode employed. But note the disagreeable burning. Would a patient like it? Hardly. Would it not be far better to avoid hurting the patient as much by the cataphoresis as you would hurt him by the operation? How can this be done?

I teach the following management of the technique of procuring local anæsthesia with reasonable comfort and no actual distress to the patient. Begin with the current at zero. Through the rheostat slowly increase the dosage up to the point of initial tolerance and stop. Wait a few seconds till sensation subsides and the current ceases to be felt. Then again advance to tolerance. Again wait till all sensation subsides; again increase the current. The final steps of progress towards complete anæsthesia are the same, and when an amount of current that you know would be intolerable without an inhibition of sensation is not felt at all, you then know that an incision with the knife will be felt almost or quite as little.

Reduce the current to zero and see if you feel the prick of a pin. The test on your self is apt to be more unpleasant than it would be on a patient who presented the conditions that require the application. Note and record the lapsed time consumed by your first cataphoresis, and if on test with the pin the anæsthesia is not complete replace the electrode and apply the current a couple of minutes more.

But if the patient has a small tumor, say, upon the eyelid, the circular, rigid and flat, electrode employed above will be unhandy. In this event, or in any other in which you need to adapt contact to a part, simply cut and fold a small piece of surgical gauze to fit the area desired, wet it with the anæsthetic solution, place it on the part and then over it apply any small electrode wet in the usual manner. Then manage the current as before.

Test the method on some dispensary patient with a view to noting the dosage and time required. The smaller the area of contact the greater the current density. Three mil. and a stop of one minute, five mil. and stop same, seven mil. and stop two minutes, ten mil. final and hold two minutes, would equal six minutes for the entire application. About as much time would be allowed after a hypodermic of cocaine.

Then incise the tumor. The patient may say he just felt a slight stab, but did not mind it. Now dress the part. There is no infiltration as from an injection. Healing is quicker and more satisfactory.

A lack of skill in attempting this measure may result in a disagreeable burn of the skin. Do not use it in practice till you have *practiced* it. Observe also that if applied to a variety of parts some are more sensitive than others to the initial dosage of the galvanic current.

50. *Drug Cataphoresis.*—The principle is the same for all drugs which are soluble. With rare exceptions, of which iodine is the chief, the drug held in solution is pushed into the tissues by the osmotic action of the positive pole of the galvanic current. For more than a generation experiments have been made in this field. Any curious physician can repeat them. The same plan can be pursued as described above for cocaine, or the part to be treated can be placed in a water-bath electrode and the drug can be added to the water. Drug cataphoresis has been greatly exploited and seems to appeal to the reason of the inexperienced. But how important is this method? If the world had only the constant galvanic current to make up the sum of electro-therapeutics it would be quite important. As to its efficacy in curing obstinate chronic diseases it must be observed that the local administration of any drug does not give it therapeutic properties beyond those stated in standard textbooks on *materia medica*. Drugs, therefore, will not cure

any diseases beyond their scope of action simply because they are administered through the skin.

The function of cataphoresis is simply to put selected drugs where they will be able to act within tissues which they could not reach in any other way. But the curative properties of the galvanic current are not changed because of cataphoresis. Its limitations are not removed a jot. Drugs alone are not very effective in the treatment of chronic diseases and the galvanic current alone will cure but few. I make but little use of drug cataphoresis *because I am able to do better.*

In my own private practice I find that the resources of galvanic, induction coil, sinusoidal and static electricity enable me to secure results in local chronic conditions that could not be expected of any drugs, no matter how they were applied. Except for anæsthesia, the use of iodine and the deposit of nascent metallic salts upon mucous membranes, the brilliant *laboratory* possibilities of "medicamental cataphoresis" contain little of actual value in *the treatment of patients.*

There are better methods by which to reach the same ends—at least there are methods of skilled technique which an expert can make yield superior results. A case in point might be considered rheumatoid arthritis, affecting the joints of both hands, with nodes, deformity, paralysis and pain. The use of lithium, iodide of potassium, or any other drugs by cataphoresis limits the electrical attack on the disease to the constant galvanic current, which is notably deficient. Aside from the current the sole attack on the disease is by a drug which is also notably deficient. The *combination* is weak, as *neither alone is successful.* By other means that are no more trouble to me and are much more enjoyable to the patient I accomplish a degree of improvement in these cases that leaves cataphoresis far behind.

51. Most physicians are familiar with the ordinary subdivision of galvanic methods into labile and stabile

galvanization, these two terms apparently covering the scope of technique in the popular mind. But how do they suggest to the operator the many shades of alteration that he can put into the action of the current if he is instructed how? A clearer conception can be expressed in the statement that certain therapeutic actions are inherent in the dynamic properties of the current (according to the dose) and the function of electrodes is then simply to place the current where it can exert its action upon or within the affected tissues, while certain other therapeutic actions are not the *direct* result of the current *per se*, but depend on the *way it is made to traverse the tissues or attack their condition.*

The *manner of the attack* decides the victory and not the volts or miliamperes of the current, hence in these cases the function of the electrode is to *direct the current so that it will fulfill the intentions of the operator.*

It is therefore easy to see that when results of treatment are decided by *the technique of manipulating the electrodes* there is room for great variation in these results. If the physician has no training in correct technique these important cases are beyond his reach and he can only treat the simpler conditions that respond to the automatic influence of the different currents.

In local applications the *inherent* properties of the galvanic current are chiefly employed for their *chemical polar* effects, for *alterative* or *nutritional* effects and for the *relief of pain*; while the same properties are *made* to have selective actions upon:

Nerve centers,
The nerve supply of a part,
The vascular supply of a part,
Muscle-fibres, and
Special pains,

by selected methods of technique, in which *dexterity, skill* and *refinements of the operator's control* have as much to do with the results of treatment as a navigator's skill and intent

have to do with the port his ship makes. Your current will fail to reach any port at all in many cases of disease if you do not know how to steer it in the right direction.

Nor is direction the only requisite to reaching port. The ship must trim, be comfortable and have speed. The captain must competently know his ship, his compass, his ocean charts and the harbor for which he points. So, also, the physician who would become expert in electro-therapeutics must learn to know his apparatus, the effects which can be produced by each different current and different doses of each current; how to produce each of these different effects when needed; and he must also know when they are needed. He must know *what*, *why*, *how* and *when* along the whole line of his work.

Start with the *diagnosis*. Then consider the correct *principles* of treatment. Next decide *what special action* will produce the *indicated* effects. The clinical picture complete, we select the indicated current, polarity and electrodes, apply them to the parts, regulate the dosage and manage the technique to the sole end of producing in the tissues the actions known to be necessary.

Scientific treatment with *electricity* consists then in knowing what particular therapeutic action the diseased tissues need and how to do what is needed when it is needed and where it is needed.

Make elementary tests upon yourself and on intelligent dispensary patients who can report effects. Study each different gradation of action that you can cause by changes of pressure and movement of electrodes with a given dose and with different doses. The *flexibility* of electricity as a therapeutic agent will then no longer surprise you.

Note how useless the *slow* labile technique required to affect the great nerve centers would be in attempting to *exercise* muscle fibres with the same current, polarity, dosage and electrode. The difference between *sedation*

and *stimulation* is in *technique* and not alone in the reading of the meter.

Note again how you must give the current *time to act* if you desire to influence the vascular suppply of a part. Note again how a change in the rate of moving an electrode over a part (with no change in any other detail of the treatment) will alter the impression being made upon the tissues and often reflect itself in the patient's face.

Study all these varied possible alterations with as much painstaking care as if you were perfecting yourself in capital surgery. Along with this study should go careful reading of the chapters on electro-physiology and physics in my other works.

CHAPTER II.

FARADIC STUDIES IN TECHNIQUE.

AN ORIGINAL DEMONSTRATION.

Induction Coil Currents Made Clear.—Qualities Explained.—Practical Tests to Develop Skill.—Accurate Dosage.—Important Methods.—Author's Original Demonstrations.

Eight things contributed in the early days of modern electro-therapeutics to make the faradic battery for a time almost the only type in actual use:

1. Its compact size and cheapness.
2. Its obvious energy as a muscle stimulator, with a single cell.
3. Its freedom from destructive injury to tissues.
4. Its apparent (and delusive) simplicity of action.
5. The work of Duchenne.
6. The undeveloped state of all other currents.
7. The misconceptions of the profession regarding electricity and neglect to investigate its properties.
8. A prejudice, the strangest and most unwarranted in recent medical history.

These factors wane as electrical science advances. In competent practice the coarse faradic battery has escaped from the hands of the physician to the laity and has been superseded by the high-tension induction coil apparatus. The essentials of this improved type of faradic battery, of whatever make, are the same. They are:

1. A set of *therapeutic coils* providing sufficient range of dosage to meet all the indications for this current.

2. A means of regulating all varieties of dosage with precision.

But induction *coils* alone do not provide the element of *quality* in a faradic current. They modify the *voltage* and *amperage* of the current, but the *character and rate of interruption* dominates even the influence of calibre and length of wire in every coil current that is employed in medicine.

Therefore a good apparatus requires (1) a standard set of coils, (2) a rapid and slow interrupter of smooth and constant actions, (3) a pole changer, (4) 4 to 6 cells, (5) a cell selector switch, (6) a primary circuit rheostat, and (7) a secondary circuit current controller.

In Chapter VII of "The Treatment of Disease by Electric Currents" I explain at length the necessary *physics* of faradic batteries, and in Chapter VIII describe in full the established *physiological actions* of this familiar form of electricity. The physician who studies *technique* must know what technique can be expected to accomplish and the reading of these chapters is indispensable. The physician who expects to succeed with electricity must be as familiar with "physiological actions" as is the mariner with his compass. Let us now proceed to study the elementary technique of using the great legacy of Michael Faraday.

52. Connect a telephone receiver by two conducting cords to the terminal posts of the induction coil apparatus. Sit in front of it so that all adjustments can conveniently be made with the right hand while holding the receiver with the left. The manipulations now practiced are to teach two things:

1. What constitutes a proper adjustment of the rapid vibrator.

2. The differences in volume of currents through different coils.

Thoroughly brighten the vibrator spring and the platinum tip. Without regard to *coil* switch a single cell into action and screw in the tip till the current reaches it and sets it going. Hold the receiver to the ear and note the sound. Also look closely at the spark discharge between the tip and the spring, so that the eye will be educated to all variations in the color and character of the spark.

Now cut down the primary cell current with the rheostat and test how far you can reduce it before the vibrator stops. Again turn the platinum tip nearer the spring so as to set it going and aim to reach the finest point of adjustment—the adjustment that will actuate the vibrator with the least current or smallest fraction of a single cell.

Now cut all the resistance out of the rheostat and restore the full action of the cell. How does the spark now sound through the telephone? Is it smooth and even or is it sputtering, rough, low pitched and irregular? The *character* of the sound denotes the *quality* of the interruption of the current.

Add a second cell and note the increased volume of sound and the greater brightness and quantity of the spark. Add a third and a fourth cell, or, if the battery contains six cells, add them all. As you increase the current note that the space between the tip and the spring which was adjusted to the E. M. F. of one cell is not sufficient to handle the current from 4, 5 or 6 cells and needs to be newly adapted to the greater tax upon it. With the maximum current there is too much spark for the metal tip and spring to tolerate, and the intense electrolytic action will speedily eat a hole into the spring and ruin it.

Vice versa, if the spark gap is correctly adjusted to carry the maximum current without deflagration, then the space will be too great to act properly if the current is reduced to one cell. The lessened E. M. F. will not cross the greater air-gap and the circuit will not be complete.

Each degree of E. M. F. in the primary current is competent to act best only through an open space (arc) which is proportioned to its driving power. Therefore practice a ready adjustment of the rapid vibrator to suit 2, 4 or any number of cells, with all variations of the primary rheostat. An expert will do it in an instant.

53. But before you can make a proper adjustment to secure correct action of the spring you must know what correct action is. If, in shadow, the spark looks bright, large, flickering and has mixed up with it secondary discharges which seem to overlap and which have a flat sound, the current is too great for the air space and the arc needs lengthening. Screw out the tip a trifle and aim to adjust it so that the discharge between the tip and the spring is violet in hue, even in rate, and equal in intensity. It will then approach correctness. Finer tests are made through the telephone.

If to the ear through the telephone receiver the sound at first comes coarse and jerky, or rough and split, or low pitched, it must be adjusted by tentative turns of the screw until it soars clear-voiced on the high key of an intensely rapid, regular and smooth vibration.

Now to secure this *efficient quality of interruptions* is the first care of the artist in technique, for it is the foundation of the action of every coil. There is a distinct relation between the quality of the interruption and the quality of the therapeutic action of the current. No coarse and jerky *make and break* at the vibrator will produce a fine and even action in the tissues. A sedative effect cannot be got out of a current that is irregular in its efforts and which often startles the tissues with a sudden rise in intensity and falls below the intended dosage the next instant.

54. The necessities for correct adjustment of the *rapid interrupter* are two: (1) Preservation of the interrupting device from excessive wear, (2) therapeutic indications.

The constant use of too heavy a spark will soon cut

through the spring of the vibrator or wear out the tip, and it also exhausts the cells. It also greatly increases the need of daily polishing. The spark oxidizes the surface of the metal. The oxidation speedily develops resistance. This interferes with the discharge. It soon demands more current to overcome the increased resistance. Smoothness and fineness are lost. Then the surfaces must be freshly brightened. Waste of current therefore means extra work.

Polishing of the vibrator will need to be done less often —a saving of trouble—and cells will last longer, if the author's rule is adopted of using *the minimum of spark that will furnish the dosage required for a given case.*

55. Next adjust the *slow interrupter* to various rates from the slowest possible—say 40 per minute—up to a coarse "massage" action of several hundred per minute. Note the same alterations as before in the quality of the spark discharge when contact takes place between the hammer and the tip. Avoid the heavy, white, deflagrating spark. Observe that slow periods require enough current to drive the hammer back a sufficient distance. Note that if not cleanly polished the full swing of the hammer may take place with occasional *missed* sparks. In treating a patient this would mean missed contractions; not a satisfactory thing to occur in practice. Therefore, see to it that all oxidation is polished off both tip and hammer.

In my personal object-lessons on the adjustment of vibrations I have demonstrated a great variety of details, all of which go to make well-nigh instantaneous and skillful precision of adjustment a fine art. In these home-clinics through which I am conducting readers each should endeavor to test every possible regulation that ingenuity can suggest. "Patience, and try again," is the motto for the student.

Command of the vibrators must be had before any scien-

tific investigation of *coils* can be made—and then the difficulties of the subject disappear.

56. Let us now again connect the telephone receiver to the terminals, switch in one cell and the rapid vibrator, and begin the comprehension of the functions of different coils.

With the direct current from half a cell place the receiver to the ear and note the attenuated sound from the attenuated coil of 1,500 yards of No. 36 wire—full and vibrant enough to represent considerable action, but "attenuated" in comparison with sounds that are to follow.

With the same small current change next to the 1,000-yard, No. 36 wire coil, and then to the 500-yard, comparing the relative amount of sound from each and thus picturing to the mind the *relative induction capacity and volume of current* of each of the three-standard lengths of this fine coil. Note that fully twice the rush of sound comes through the telephone from the shortest wire with the least number of turnings, the length which has the least internal resistance to the current.

57. Now contrast the *induction capacities* of No. 32 wire with the preceding 36 wire. Try first 800 yards, this giving greater reverberation in the ear than 500 yards of 36. But 500 yards of 32 is decidedly louder, while the short 300-yard coil of 32 wire is louder still.

From this shortest 32 coil go back to the long 36 coil and the diminished volume of sound will convey a very clear idea of the diminished *amperage* of the current. Now test the coarsest coil of the entire secondary series—154 yards of No. 21 wire—and hear a near approach to a roar as the lessened internal resistance demands less *voltage* to act upon it and the *amperage* accordingly rises in the balance. Test the primary coil in the same way. It is a little less resounding at this stage of our investigations.

58. Now test the effects of running all variations of

current-strength through each coil in succession. Then make rapid shifts of coils. Physicians fortunate enough to possess the author's improved battery may run the arm of the cell selector switch from right to left and from left to right. Almost a *diapason* of sound will be demonstrated and an accurate idea obtained of the rise and fall of E. M. F. according to the calibre of the wire and the number of its windings.

59. Next take one tip in the hand and with the rapid vibrator in action make slow interruptions at different rates to test the wide range of action that can be obtained in this way by practice and skill. Then practice the "swelling" method by running up and down the resistance in the primary rheostat and you will get a fair idea of what goes on when you make similar changes in treatment of a patient.

60. The great advantage of these tests is the accurate comprehension of the *increase of current volume* which takes place in proportion to the *decrease of internal resistance* as the windings of wire decrease in number, and also as the calibre of wire is increased. This is accomplished with the aid of the telephone, as taught by the author, without taxing the operator's comfort as similar tests with electrodes acting upon the physican's muscle would tax it.

If these tests are made with the "*direct*" current in the above described manner they are tolerable to the normal ear, but if too much E. M. F.—say two full cells—is used the storm of sound that rises from the short coils is painful to the delicate organ of hearing, while 3 cells make even the 36 coil exceed the sense of comfort.

61. But there is a still more necessary lesson to learn before putting away the telephone receiver; a lesson rarely studied by physicians outside of my own classes, but which contains the key to a clear understanding of the *therapeutic value of different coils, and the reason why a*

variety of coils is indispensable to the competent treatment of patients.

The demonstration requires a current controller in the circuit of the *secondary* induction coils such as is furnished in the improved faradic apparatus devised by me and in successful use since 1894. The *direct* coil current involves the use of the *unrestrained maximum* current of the given coil in every application, subject only to variations in the *primary* exciting current, or in the extent of coil employed. *By passing the induced current first through a scaled rheostat we can restrain the maximum voltage to any degree and make a scientific study of the characteristics of the different coils. This rheostat and method of study originated with me in 189½.*

Switch into circuit 3 cells and the rapid vibrator. Insert all the resistance in both tubes of the secondary rheostat, place the switch arm on button numbered 1, and start the current into action. Test the note of sound made by the 1,500-yard No. 36 coil through all the range of tube No. 1, and observe the gradual and even increase of sound as the spiral rod descends in the fluid towards contact with the base.

As the rheostat resistance *lessens* the volume of high pitched sound *increases*. Move the arm on the switchboard to tube No. 2, which has but one-tenth the resistance of the first tube and repeat the test. Especially note in these tests with the long fine coil—1,500 yards of No. 36 wire—that the sound echoes through the telephone in comparatively great volume, as if driven by great voltage.

Throw the switch in rotation on tube No. 1, tube No. 2 and the "direct" current and you will hear the ratio of sound increase in about even steps of one, two, three. This means that the voltage of this coil is great enough to project about one-third as much sound through the entire resistance of tube No. 1, and half as much through tube No. 2, as is produced by the direct *unreduced* action

of the same coil. The high tension—high voltage, or E. M. F.—of this coil diffuses its thin action—*amperage*—through great resistances. Remember this.

62. Next repeat the same tests with the 1,000-yard No. 36 coil. Through the high resistance of tube No. 1 it resounds less than did the longer coil of the same wire, *i. e.*, it has less *voltage* to push it. Through the one-tenth resistance of tube No. 2 its sound is much louder than was the sound of the 1,500-yard coil of the same calibre, *i. e.*, through this smaller resistance its voltage suffices to project the effects of its increased amperage. Its action is more *localized.*

63. Now throw the switch arm to the "*direct*" button and the sound swells to a roar that would speedily make the ear ache—proof that its capacity to produce sound is greater than that of the longer coil when neither is *restrained* by resistance in the external circuit.

64. Note that with the 500-yard coil of No. 36 wire the contrast becomes still greater. The high resistance of tube No. 1 modifies its volume more; it swells more loudly through the resistance of tube No. 2, and with all resistance out its roar with three full cells is deafening. Run each rheostat separately up and down its full length and familarize yourself with alterations of dosage.

65. Now carefully repeat the same tests with the 800-yard No. 32 coil. It comes gentlier through the full resistance of the high tube, as if it was a weaker current. Its "weakness" is merely the altered proportions of *amperage* and *voltage* in its inductive capacity. Through the feebler restraint of tube No. 2 it again swells louder and with fuller volume. It is about three times as resonant as before. Its action is more localized. It will be shorter and thicker and more local in the tissues when applied in treatment.

66. But to realize how the mild resistance of this rheostat cuts down the maximum—unregulated—action of this coil we must quickly switch from tube No. 2 to the

"direct" button. Its clinical lesson needs no comment. It is a conclusive demonstration to the operator.

67. Pass next to the 500-yard 32 wire coil and repeat all the contrasts of action before noted and compare them with each other. It is study of great interest without a dull moment in it.

68. Now test the still shorter and thicker coils whose fewer windings exert still less influence in developing high voltage, and whose thicker cross-section of wire swells the *quantity* of current carried. With the coil of 154 yards of No. 21 wire the sound waves are gentle and seem upon the *surface* of the ear when the electrode of resistance tube No. 1 is at the top, and only swells into the inner ear when the rod descends below the middle of the tube and nears the bottom. Through tube No. 2 the sound is loud at first, and before the rod reaches the bottom it fills the ear like a blast from a fog-horn. Through the "direct" circuit the receiver must be taken from the ear, so furious is the onslaught of sound that strikes it. *Greater localization* of action, *less diffusion* of action within the tissues, is the emphatic lesson of this test.

69. The primary induction coil can next be tested in the same way. That its *voltage* is small is proved by its small voice through the resistance of tube No. 1. That its *quantity* of current is much greater than its voltage is proved by its action through tube No. 2. Also that both energy of action and volume of action are less in the first induction coil than in the second step of the inductive process are proved by comparing the more superficial roar of the direct primary coil current with the deeper, more penetrating, ear-splitting intensity of the direct current from the secondary coil last tested.

70. Now repeat these important *dosage tests* from the standpoint of *amperage* instead of voltage. Note that through a given resistance in the secondary rheostat the apparent increase of current-strength is felt *as we pass from short to longer coils*, while with the "direct" current

this is *reversed* and with a given E. M. F. the intenser action is felt as we pass from *long* to *shorter* coils. With the switch arm on the author's apparatus you can run a complete scale from high to low notes in both directions and soon master the necessary facts. *The principles involved apply to all faradic currents and all faradic batteries of every make.* I wish it to be understood that throughout this manual I am teaching *principles* for *general use* and not merely the use of some special apparatus.

71. Having now worked out the above principles, the clinical significance of the set of approved therapeutic coils becomes apparent. Have they, as is so often ignorantly said, *different* actions? No. They act along the same line and in the same direction, providing degrees of dosage by differences of *driving force* and *thickness of blow* struck in the tissues; some carrying it farther than others when diffusion is needed and some stopping short of others when narrower *localization* is needed; some affording small dosage when delicacy is required; some furnishing the means of increasing the same current to suit also the needs of larger administration.

With the aid of the rheostat they enable the operator to scale the dose as may be necessary to procure the definite effects which should result from proper treatment. These effects do not *reside in the coils*, but are the product of the properties of induced (intermittent) currents multiplied by selected technique, and modified by the state of the tissues treated.

All three factors combine to produce any one or more of the possible effects of "faradization." Varied action depends on varied dosage. The action of a laxative, for instance, varies with its dosage, and so does the action of every electric current. Coils of different inductive capacity *vary the dosage* of coil currents, but *do not create new currents, new properties, new actions*, or *new effects.* They differ in *degree*, but not in *kind.*

As essential dose regulating devices these divisions of

coils not only give us control of *voltage*, but they enable us to reduce the *amperage* when little is required, or to increase its volume when more is required, without compelling such alterations in the *primary circuit* as would impair the smooth working of the interrupting spark-gap, or cut the metal of the spring by an excess of electrolysis.

72. Just here let an important consideration divert us for a moment from actual tests for the sake of further understanding.

Amperage will do work of great range almost independent of *voltage*. Voltage will do no work independent of amperage. We place our hands on the opposite poles of a large static machine, the type of high-potential electricity. The current passing through the body does no work that can be detected. The tissues feel nothing and no tests can demonstrate any action upon them. The "voltage" may, indeed, be *high*, but a high wind may also drive a grain of sand with great speed against a stone wall and the mere speed affects nothing, for the missile has no *weight*. But mass the projectile till it weighs an ounce, a pound, a hundred pounds, a ton, and watch the work that the same speed performs with the greater volume and weight of weapon. So the static current does no work while it is a thin stream of however high voltage, but when we accumulate quantity (*amperage*) in the stream the voltage acquires efficiency and therapeutic action results.

Going to the other extreme of illustration, we scale down the voltage of a current possessing at first say 100 volts and 5 miliamperes. Reduce the circuit resistance. Let the *volume* rise on one side of the balance as the *volts* drop on the other. The *amperage* does not lose its *electrolytic* action; on the contrary, it gains the more as its volume swells, and presently, when scarce any *volts* are left, the *amperage* becomes a *cauterizing* agent that will

sear tissues or boil water if applied through a platinum loop.

There is, of course, no action from *volume* without any *volts*, and there is no action from volts without any volume; but with a minimum of volts there may be an enormous action from sheer *volume of current* if it is utilized in the right way. Neither factor alone is a therapeutic weapon minus the other. Both combined vary the action *in proportion as their ratio varies, and the power to alter their ratio at will is a large part of our means of regulating dosage in practical therapeutics.*

If both voltage and amperage were *fixed values* that could only be diminished or increased together *in equal proportion* we could not use electricity with safety. The *elastic flexibility* of its great powers would be lost. Have I made the subject clear?

The physician should so familiarize himself with these primary facts that his mental picture of ohms, volts and amperes is as concrete and definite as is his conception of pounds, horse power, magnitudes above the million, intensities of the sun's heat, or the vibrations of light waves. A *pound* is a purely arbitrary term which we grasp the significance of in practical use. The discrepancy in size between a pound of feathers and a pound of lead does not impair our conception in the least. We can neither see, feel, nor even count a billion, but we form a mental picture of the value behind the word that serves for our practical application. So it is with ohms, volts and amperes in the actual familiarity of daily work. The terms are no more arbitrary or difficult than were the words foot, pound, meter, quart, dollar, bushel and all terms of comparative measurement, before we learned their meanings by repeated and intelligent use.

While the *physics* of faradic apparatus are treated fully in my text-book on "The Treatment of Diseases by Electric Currents," yet so many are far from clear in their minds regarding inductive action that a single sentence

here may be of use. Therefore, note that the *voltage* of a *secondary coil* current is proportioned to the *amperage of the primary cell* exciting current governing the degree of *magnetic saturation* of the bundle of inducing iron rods, multiplied by the number of *convolutions of wire* wound around the secondary spool, divided by the internal *resistance.*

73. We will now begin where we left off. To still further teach *the elements of dose regulation* to physicians who have never before comprehended it, detach the telephone receiver and connect the bi-polar electrode illustrated in Chapter XV of my work on "The Treatment of Diseases by Electric Currents." Lightly rest the tips of the first and second fingers on the opposite halves of the electrode and start the battery with two cells. Take the "sedative" fine coil, 1,000 yards No. 36 wire. Reaching the fingers through all the restraining resistance of tube No. 1 we observe that it is indeed a soothing, sedative and gentle current. It feels so, and is so. But a slight move of one switch brings it to the fingers through the lesser restraint of tube No. 2, and is it now *sedative?* Is it a sedative coil simply because it is a long coil, or fine coil?

The operator whose fingers are on the electrode will reply that now it is not sedative at all; that even "stimulating" would be too mild a word; that it is *rasping* and *annoying* to about the limit of endurance.

Next, another rapid throw of the switch to the "direct" current *with no controlling resistance in the secondary circuit* drives the fingers from the electrode with a stab of pain, and proves that the *sedative* action is the action of a *regulated dosage* and not the inherent effect of this size and length of wire wound into a coil.

74. Now take a so-called "stimulating" coil—300 yards of 32 wire—and repeat the test. Through the full column of resistance in tube No. 1 no current reaches the fingers now. It only becomes perceptible when the rod

is lowered more than half its length, and still an inch lower the current of this short, "coarse" coil feels like the gentle purring of a lullaby to the tissues. It is as *sedative* as the ideal conception of the long, fine coil and *cannot be distinguished from it by any expert who does not see the switch-board.*

Turning the spiral rod nearer to the base of the tube the current gradually takes on the sharper character and *bite of increased amperage*, but its low *voltage* appears in the fact that nearly all the resistance of the tube must be cut out to let the current through. It does not *diffuse* its action; its lesser E. M. F. *localizes* it.

75. On switching to tube No. 2 the current is barely felt when the rod is at the top. At the middle of this tube it is still sedative and has gently increased from zero to a decided grasp on the tissues. Contrast this now with the intolerance soon manifested by further lowering the rod in tube No. 2, and by the terrific thrust from one instant's contact with the switch on the "direct" button. Can it be possible that a single coil should "blow so hot and cold?" Should so soothe and so heavily strike?

76. We have already seen that the *facts* are that *each coil has its range of dosage*; *that these coils cover similar actions on a larger or smaller scale, with larger or smaller areas of contact upon the tissues and with greater or less resistance in the tissues and external circuit. These similar actions can be made to overlap each other by dose regulation throughout that part of the range of each coil in which voltage is equal.*

It is very simple. Two travelers in the desert may carry water for drink—one a gallon and the other a quart; and there being four quarts in a gallon the one has four times as much total volume of water as the other. But in their ability to fill a single glass to the brim and quench an ordinary thirst they are on equal terms. The relation of coil currents to each other in some part of their lesser dosage is the same, as is well

illustrated by a diagram which I have employed in the instruction of my students.

77. In all the foregoing experiments we note that the basic store of primary current is unchanged in its total amount. If the battery has four cells at the beginning it has only four cells at the end. By the mechanical devices of *coiled wire* and an *alterable resistance* we induce, however, such changes in the *proportions* of the current as makes it short and thick, or long and thin, as we desire for medical use. You can shape a ball of molasses candy in the same way. You can *localize* it in a thick mass or you can pull it out into a long, thin rope. No matter how you change its shape the net amount of candy remains the same and is not increased by manipulating it.

78. Understanding now the intrinsic relations of coils to each other, and the principle of changing the ratios of voltage and amperage as required for dosage, let us next take up the study of *technique.*

This can best be begun by grasping a small sponge-covered electrode in each palm, although no such application is ever required in therapeutics. Employ first the slow interrupter with a rate of about 100 periods per minute. Direct the current through the first induction coil—the so-called "primary" coil—and adjust the dosage to produce the *standard elastic muscular contraction* taught in this manual. (Section 21.)

Note that the low voltage localizes the action of the amperage (the contractions) very near the electrode. The interossei contract and the maximum blow of each period is *below* the wrist. There is little diffusion of the work done in the tissues.

79. Now bare the whole arm and watch the difference in the gradually lengthening wave of contraction set up by higher degrees of voltage, observing the greater energy of the negative interrupted current, to which I shall refer in these tests. The shortest of the second in-

duction coils—154 yards of No. 21 wire—with the same standard of contracting dosage acts upon a greater number of muscle fibres, but still localizes near the electrodes according to their situation.

80. The same is true in other degree of the next size of secondary coil—300 yards of No. 32 wire—but the blow reaches *above* the wrist to the flexor muscles of the forearm. With the next coil—500 yards of No. 32 wire—the increasing voltage drives the contracting current along more fibres and *extends the center of localization*. The wave of action can now be perceived at the elbow with the dosage again standardized.

81. A little higher dosage drives it to the triceps, and acts upon the muscles of the whole arm to the shoulder. The next increase of E. M. F.—800 yards of No. 32 coil—adds a degree to the *diffusion of action* from the electrodes in the palms to the muscles as high as the shoulder, with the maximum localization still higher than it was before. The blow is still felt in the wrist, but it is also felt far beyond the wrist, which was not the case with the two short coils of lowest voltage. With the longer coils the attention is diverted from the hand to the arm, where the crest of the wave of action now reaches its height.

As each successive step in *pressure force* swells on the current through a greater reach of tissue it is seen that the different degrees of voltage operate partly or mainly *as a means of diffusing the amperage of the current over a longer path of action*, thus varying the *extent* of muscle that contracts.

82. Test now the 500-yard No. 36 coil, with its next upward step in voltage and consequent attenuation and diffusion of volume. The same principle as before holds good. With the standard dose again adjusted and the arm dependent, resting above the elbow on the inner thigh, the action upon the hand and wrist is almost negligible, and the forearm rises and falls with more marked

and vigorous flexion. With the 1,000-yard No. 36 coil of still higher voltage the *diffusion* extends to still more fibres, and the *quantity of current action localized on any given inch of tissue is, in the same ratio, less.*

83. When the 1,500-yard No. 36 coil is at last reached the contrast is marked and the drop in volume of action makes the current seem much "weaker" at a given point, But increase the dose to the full standard and we again find strong contractions spreading over a wide area.

84. Is the therapeutic property of the last coil a *different* property from that of the first? No. Its contractions differ in *degree*, *quality* and *extent*, but *not in kind.* One acts on many fibres and is diffused; the other acts on a small area near the electrode. Is the *total* action of one greater than the other? No. One is shorter and thicker; the other is longer and thinner in its stream of electrical discharge.

It is as if the current induced by say three primary cells was represented by the imaginary sign, *xy12*—a total current made up in the output of the different coils by different proportions of voltage and amperage which we may illustrate by the following table:

Primary Coil.....		Voltage....	x	2	plus	Amperage	y	10 =	Current	$xy12$
Secondary Coil, No.	1.....	"	x	3	"	"	y	9 =	"	$xy12$
" "	2.....	"	x	4	"	"	y	8 =	"	$xy12$
" "	3.....	"	x	5	"	"	y	7 =	"	$xy12$
" "	4.....	"	x	6	"	"	y	6 =	"	$xy12$
" "	5.....	"	x	7	"	"	y	5 =	"	$xy12$
" "	6.....	"	x	8	"	"	y	4 =	"	$xy12$
" "	7.....	"	x	9	"	"	y	3 =	"	$xy12$
" "	8.....	"	x	10	"	"	y	2 =	"	$xy12$

In every case the resulting total of *thickness* plus *length* is the original product of current *xy12*, but the *proportions* are changed by the device of the *coil*, which cannot, however, add a single iota to the sum of the current. The correct modification of the total current of the battery is the problem of regulating the dose.

Each coil then is part of the *dose-regulating device* of the apparatus. The action of the 2,500-yard fine coil may appear to the tyro to be different from the action of the 500-yard No. 32 coil, but that is because they do not act on the same tissues in an application with an *unregulated* dose. One acts upon a wider field; the other is more local, when equal voltages are used with each. But if we adjust the voltage so as to restrict the amperage *to the same area of action* we find that we can duplicate the same effects.

85. Additional clearness of this plain proposition will be obtained by repeating the same tests with the rapid vibrator. First take the 1,500-yard No. 36 coil and adjust the dose to a strong grasp of the flexor tendons in the wrist with its maximum about three inches up the forearm and tolerance just inside of discomfort. The vibratory sensation extends along the arm to the shoulder before it ceases to be felt. Switch to the 1,000-yard coil of the same wire, and the lessened *wave length* and increased *wave height* intensifies the *localization* of the wave crest, and the same primary E. M. F. is now painful near the wrist. Adjust the dosage to the original standard of tolerance and note that comfort is restored. The vibratory sensation also extends about as far as with the longer coil, but is less pronounced as it leaves the wrist.

Repeat the same test with the 500-yard No. 36 coil. With any dosage within the limit of tolerance when the contraction reaches its local maximum of elasticity the extension of the wave now dies out below the elbow. The 800 yards of 32 wire in coil demonstrates its higher voltage and greater capacity of amperage and takes a larger grasp on the tissues than the finer coil of a third less length.

Carefully vary the dosage with this important coil. Flex and extend the arm and note every degree of alteration you can produce. With fair comfort it can be made

to reach the biceps, yet its local action is concentrated on *fewer fibres* than the 36 wire coil, hence the tyro will say it is "stronger" or more "stimulating."

When used, however, with competent understanding we employ it to adjust the dosage to special ends, and make it strong, weak, tonic, sedative, nutritional, stimulating, or exactly what we desire, within the range of induced current action, and according to the indications of the case.

Pass next to the 500 and 300-yard coils of No. 32 wire and observe the increasing intensity of local action as the wave length of action retreats and grows shorter and thicker. With any dosage below tolerance they do not act upon all the same muscle fibres as the longer coils, but on a reduced area of tissue and with dosage adjusted to produce a standard degree of contraction in each test this demonstration elucidates completely the subject of different faradic coils and the differences between them.

This elucidation appears to have originated with me, as I discover no report of a similar demonstration in electro-therapeutic literature, and my students all say that they never heard of it before.

86. I teach, however, one more exceedingly interesting test ere leaving this feature of faradic work. With a thumb pressed on the opposite electrodes, switch into circuit the entire coil of about 8,000 feet and regulate the dosage to a standard degree of sensory effect through the secondary rheostat of high resistance. The voltage of the long coil equals then a certain action through a certain resistance.

Next shorten the full coil by cutting out the No. 21 wire and note the result. The sensation is slightly reduced, and to raise it to the standard established for this series of tests we must *lessen the rheostat resistance* to *offset the loss of voltage.* Observe the necessary amount and again shorten the coil. Repeat these steps through the entire series and observe that as the pressure force less-

ens we cease to feel the dosage which was the previous standard, and to restore the standard action we must correspondingly reduce the resistance to the current.

As the coils shorten we note that the *area of maximum action* near the electrodes become more and more *local.* But it is not a *different sort* of action, and *the proper adjustment of the dose* at once demonstrates the accuracy of my conclusions regarding the purpose of dividing the secondary coil into fractional lengths and wires of larger and smaller calibre.

87. At this point I shall stop a moment to clear away an old and popular error on the subject of voltage. When "high frequency discharges" were being exploited a good deal by sensational electricians for advertising purposes, a paper on their effects was read before a scientific body by a distinguished electrical engineer. He had "during the past two years made special inquiries into the cause of the *harmlessness* of high frequency currents. No previous explanation explained it. Currents of less than 2,000 volts were fatal to life, while currents of 200,000 volts were passed through the human body with impunity." Diagrams of coils, condensers, etc., were shown to illustrate the author's remarks. He held that "*the true cause was physiological and due to some peculiar relation between nerve excitation and high frequency currents.*"

When we thus see a high priest of electrical science so befogged in his volts and so lame in his physiology it is not wonderful that readers of sensational newspapers are led astray. It is not true that "a few '*volts*' destroy life, while a great number of 'volts' do not." The error is an exceedingly primitive one, but has been given wide circulation. The error consists in attributing the destructive agency to the "volts." We might say as a parallel case that a bullet driven by a low explosive will kill a soldier, while a bullet driven by a high explosive will pass through his body with impunity. But what about the size of the bullet? A Mauser bullet often goes

at high speed through the tissues of the soldier and leaves him on his feet, but would a cannon ball at the same speed do the same thing? Is there any room for argument about it? A giant shell from one of the great guns of the Oregon would crush a man if it simply fell on him while a rifle shot of Mauser calibre reduced to equally low speed would lose its destructive properties altogether and become harmless.

The dangerous electric currents are not dangerous *because* they have low voltage, but they are kept down to low voltages, because otherwise they would be too dangerous to handle. There are dynamo currents of crushing size—one, two, often ten, amperes; currents that want no aid from higher pressures to destroy life if applied for that purpose. But would it make a ten-ampere current "harmless," so that it "would pass through the human body with impunity," if we simply raised its low voltage to 200,000?" Or make it more harmless by raising it to a million? At a couple of millions would it become a child's toy? If the alleged theory is correct, why not?

But the mind staggers at the thought of two million volts and ten amperes of current in one discharge, and no one wants to be struck by *lightning*. The theory is simply wrong. The "harmlessness" of any high potential electrical discharge is in proportion to its volume, not its volts. Proof is afforded by the static machine. With a large machine produce a current estimated at about 200,000 volts, grasp the two poles and you do not feel anything. The *amperage* is too small to measure and is probably a fraction of a single miliampere. Insert a pair of half pint Leyden jars in the circuit and test the discharge with the same voltage. Try it with a pair of quart jars, and next with a pair of half-gallon jars. By this time your thirst for knowledge will be appeased. The demonstration will be complete enough.

As long ago as September, 1894, I wrote my views on this subject as follows:

"The question is probably a simple one of amperage. High frequency and high potential currents would be deadly enough if they added *quantity* of current and *length* of *oscillation* to their enormous electro-motive force. Exceedingly rapid oscillations may be comfortably endured by part or all of the human framework so long as the to-and-fro swing of the movement is infinitely small. A sense of numbness may be occasioned as the result, and this is utilized in various local methods of treatment by mechanical vibration. If, however, the rapidity and force of mechanical motion was joined to a to-and-fro swing of even a few inches, the violence of the shock would utterly destroy the victim. The same principle applies alike to electric and mechanical oscillations, and renders Professor ———'s ingenious and mysterious theory superfluous."

But in the foregoing discussion the mysterious "harmlessness" of certain currents was alleged to depend on high frequency along with high voltage. I refer to this part of the fallacy in my editorial comments of 1894. The length of the electrical movement in the tissues obviously depends somewhat on the time allowed the current to get into the tissues before it is cut out by an "interruption," and hence a *high frequency* of interruption checks the wave length. Then an increase of current will drive in a longer wave between the interruptions. I demonstrate to all my students in static technique that its "frequency" can easily be made so "high" that there will be no oscillation at all in the tissues. Obviously, then, such a rate of "frequency" would nullify the action of a *small* current and render it harmless. But *ten amperes* of current would be a different matter!

88. Let us now test the changes in effect which result from changing the *rate of interruption* of induction coil currents, i. e., altering the rate of change in the tissues by increasing or decreasing the "frequency" of the pe-

riod of *current action* in alternation with the period of *inaction* or rest. It is a fruitful subject of study, and practical tests are worth more than many hours of theoretical discussion.

Begin with the slow interrupter carefully adjusted to a very slow rate, say 30 per minute, which is about as slow as I can adjust my own apparatus. Take any coil, or at first select the 800-yard No. 32 coil as a happy medium for producing muscular contractions.

Grasp an electrode in the palm of each hand and from zero gradually advance the current until the author's standard dosage for elastic contraction is reached. Note that the muscles are exercised for *tonic effects* with entire comfort and good results. There is a period of complete relaxation after each period of work and hence there is no fatigue, but rather a sense of refreshment and new strength.

But note the time required to make a sufficient number of contractions to produce the therapeutic effects of a full treatment. The *quality* of work done is all right, but it is so *slowly* done that it wastes time. Muscles will contract and relax oftener than twice a minute, and the guide then to frequency of period for muscle-exercise is the contractile quickness of the muscle fibres.

89. Turn the speed-regulating ball on the arm of the slow interrupter a screw thread farther from the center and increase the rate of action to 50, 60, 70, 100 per minute, and note that there is still a period of complete rest between every jump of the muscles and the quality of the work done is the same. So long as this is the case, the rate is within tolerance. But now increase the rate to 125, and next to 150. The more rapid contractions shorten the *period of rest.* Although in all other respects save frequency of *make and break* the dosage *remains unchanged,* yet there is a gradually increasing sense of *increasing intensity of dosage.* At 170 periods per minute note the difference in work done in five minutes at this rate, and

the work done in five minutes with the rate at 50 or 100. Comparison of total amount of work done by 850 contractions as against 250 or 500 will teach much in this field of investigation.

90. Now test rates above 200. Two hundred and twenty-five, 250 and up to 350 can easily be counted. Beyond these you can estimate the increasing frequency as you make the rate a little faster and yet faster still, until the range of the slow interrupter is exhausted. Your muscle fibres and nerves of sensation have kept pace in interpreting the lessons of these tests and you have only to quickly run back the speed-ball to near the center (with the actual current still unchanged) to note that *pain and exhaustion* or *refreshing benefit* are locked up in the balance between work and rest. If the period of rest is *short*, the *intensity* of work done must be low in proportion. If the intensity of work done is *high*, the period of rest must be *long* in proportion.

The dosage of current with which we began this test was well within easy tolerance at rates of contraction near 100 per minute. The same current was tiresome as the balance between rest and work became lost in a preponderance of *work*; and when time allowed for relaxation released the tightened fibres but half or quarter of their length there ceased to be any longer a period of complete rest. Simple fatigue then passed rapidly into pain as the rate increased beyond physiological limits.

But observe here that a reduction of the current at once removes the pain and restores the tolerance, hence the *true dose regulation* must take into account these flexible factors and adjust them to such an equilibrium that the *exact quality and quantity of therapeutic work* will be done that we desire done. Become familiar with the touch and feel of muscles doing different intensities of work, so that you will need to ask no questions when adjusting the current to any grade of contraction.

91. There yet remains the study of alterations in very rapid rates of change. Adjust the rapid vibrator to a low,

coarse note of sound and the sound will express a comparatively slow interruption of the current. Adjust the current to produce an energetic tetanus of muscles acted on without over-strain of the normal elasticity. Mark the quiver and quality of tension in the muscle fibres. Then screw up the platinum tip until the highest, clearest, smoothest possible note is reached. The rate now is nearly doubled. Contrast the quality of tension in the muscles now with the previous slower rate and you will understand the adjustments best suited to sedative effects and to stimulating effects.

But the current can only reach the patient during the period in which the circuit is *closed*. If this period is made less and less *by more rapid rates* it will reach a point where *interruption* nullifies *action* in increasing ratio till it finally cuts short the perceptible action altogether. With medical currents this ratio of frequency will vary according to the voltage and amperage, but even the maximum voltage will fail to push the action of *make* far enough into the tissues to take effect if the *break* of contact follows faster than living tissues can accept and respond to excitation. Therefore the *frequency* of any current (its rate of interruption) must in electro-therapeutics conform to the action upon the tissues which is the indicated treatment. It must range from the slow rate and long wave proper for anti-paralytic contractions or mere muscle exercise to the short wave, rapid rates for nutritional, tonic, alterative, stimulating, or sedative and anti-inflammatory effects. These last are estimated to range from 15,000 to 30,000 periods per minute.

92. Some have asked if still higher rates than these would not be better. Some have thought that the greater the speed the more remarkable would be the effects, and some have talked of making a faradic battery permitting 100,000 breaks per minute. About 1894-5 there was much academic discussion of this subject, but none put the theory to practical test until I demonstrated the

obvious fact that an excess of *break* in medical currents would lessen the effect and at last destroy the whole purpose for which breaks are made. Those who used only galvanic and faradic currents could not test so simple a matter and argued about it in vain. With the static machine at hand debate was useless, for proof did not require five minutes.

What I then demonstrated may be found in my original article published August 25, 1894, entitled "An Improved Upright Portable Faradic Apparatus with Resistance Scale for Accurate Dose Record."

93. The scientific faradic battery of to-day with its present interrupting device is admirable for small work, but is only suitable for small work. A heavy primary cell current attacks the device where the tip and spring meet and rapidly oxidizes the metal. It is most satisfactory with the smaller currents of from one to four cells, but the local intensity of muscle contraction provided by a short coarse wire induction current could not be obtained from a long fine wire coil without a great increase in the primary inducing current. Then it could be, but to tax the vibrator with the amperage of six or ten cells would involve drawbacks that are more easily avoided by altering the dosage through a reduction of the area acted on rather than by forcing a great E. M. F. to work under a great disadvantage. This puts a limitation upon the usefulness of the battery, but still leaves it a distinctly valuable type of apparatus.

I have devoted much attention to faradic currents, as is evident from the association of my name with the battery devised by me in 1894 and which retains its position without a superior in the field. While occasionally a physician unacquainted with my extensive researches in all branches of electro-therapeutics may ask if I use in my practice anything but static electricity, the fact is that it is chiefly my great experience with galvanic, faradic and sinusoidal therapeutics which modifies, rounds

out and establishes my authoritative judgment in the therapeutic field of static electricity. Except for my researches in all currents I could not properly judge of the merits of any one.

On the other hand, I have been asked by other physicians if I had a static machine! I have also been asked if I "ever got any good results" with a static machine! Also if I ever did any X-ray work. I speak of this simply to show that if some imagine me to be an "enthusiast"(sic) on static electricity others inquire if I have used it at all. The truth is that my writings and my practice cover all currents. My students soon remark that my only guide to the choice of any current in clinical work is the therapeutic indication of the given case, and that I have no "hobbies" of any kind to impair an impartial judgment.

94. We are now ready to take up the practice of *technique*. Applications of faradic currents in the treatment of patients may be:

Local.
General.
Stabile.
Labile.
Positive pole.
Negative pole.
Bipolar.
Primary coil.
Secondary coils.
With bare metal electrodes.
With covered electrodes.
With water bath.
With current slowly interrupted.
With current rapidly interrupted.
With curent rapidly interrupted, intermittent.
With current rapidly interrupted, swelling.

Two forms of technique may be combined in one seance. The active electrode is never *large*. There can be no *general* application except by a succession of *local* applica-

tions. The density of coil currents is proportioned to *the area of contact of the electrode*, and this is an important factor in dose regulation. The greatest therapeutic action is near the electrodes. With *widely separated* electrodes there is very little *interpolar* action that is either general, chemical, dynamic or important.

The chief work of the current is done near the electrode, and *through* and *by* the *method* employed to make the electrode *direct the action* of the current to meet the special indications of the case.

95. The variations of the physiological actions of coil currents and the comfort and benefit of patients depend on:

1. Proper quality in the currents.
2. Choice and preparation of electrodes.
3. Correct dose regulation for purpose sought.
4. Correct technique.

Untrained, raw, heedless, guesswork *technique* will spoil any dose regulation and will misuse the best electrodes or apparatus ever bought. The foundation of skilled technique is intelligently directed experimental study upon your own tissues and upon special patients who can illuminate the dark places of ignorance by clear replies to the thousand and one questions you should ask them. Before you can make electrodes play *therapeutic tunes* with currents on morbid tissues you must practice the notes, chords and scales that tunes are constructed out of.

96. To begin: Strip to the waist and sit on a large electrode connected with either pole at first. Take a medium-sized bare metal roller electrode and learn how it *feels* and how it *acts* on each and every part of your body and arm that you can reach while adjusting the switches with the free hand. Note the difference between effects when the contact is soft, thin, smooth skin over thick muscles—when the skin is thicker and covered with more or less hair—on motor points—off motor points—near and over joints—with different coils—with different

rates of slow and fast interruption—with different polarities—different degrees of pressure and different rates of labile change.

97. Then compare thinly covered, thickly covered, slightly dampened, well moistened (plain), well moistened and soaped electrodes throughout the same line of tests, so that familiarity with every shade and degree of action will enable you to at once make proper choice in actual practice. It may seem a little tedious at times, but it is absolutely necessary.

98. Then test the relation between *size of electrode* (area of contact) and *efficiency of a given current-strength.* Adjust a medium dosage and note the loss of density as the size of the contact is increased, and gain in density as you change to smaller and smaller electrodes. This will teach *the equalization of factors that make up the sum of current-strength.*

99. Now select any secondary coil and any electrode and apply it to any convenient part, with the rapidly interrupted current adjusted to full tolerance through the fluid rheostat of the secondary circuit. Test the effects of sudden switch changes, such as reversing the poles, moving the coil selector arm from one coil to another, adding an extra cell, etc. Any movement of any switch *breaks* and *remakes* the circuit. Note that the resulting *blow* is very small if the dosage is raised by the change and is *nil* if the dosage is lowered. This test will teach you with what confidence you can make desired changes in treating patients, without the trouble of reducing the current to zero or disconnecting an electrode.

100. Now switch the current controller from the fluid rheostat to the "direct" circuit, so that dose regulation will be solely via the primary rheostat. Attempt to repeat the same series of quick changes that you comfortably made before. There is no need for comment. If you make one faithful trial the lesson will last the rest of your life. The difference in the force of the blows struck by

the *make* current is fully explained and discussed in the chapter on the "Essentials of Faradic Electro-Physics" in my book on "The Treatment of Diseases by Electric Currents." As an object-lesson one thorough test ought to be sufficient to teach the proper care to exercise with patients.

101. Now take two tumblers of equal size and nearly fill them with warm water. Connect them with the poles of the battery by a pair of the author's "sinkers." Stand them side by side and put the thumb in one and two fingers in the other as deeply as you can. Adjust dosage to comfortable tolerance with any coil. Add a little bicarbonate of soda and note the difference. Then slowly raise the parts so that the area covered by water gradually lessens. Note the change in intensity of current action and shift the dose to suit. Learn to make the action equal at different depths.

Test different coils. Lift the fingers and thumb out of the water and then return them while the full current is maintained. One object-lesson of this kind will teach how a patient should not be managed with respect to water-bath electrodes of any size, from a tumbler to a tub. The principle is the same.

A volume of directions would be less illuminating to the mind of the operator than these simple tests. They speak for themselves and speak a language that can be *understood*. They are elementary in importance and *no technique is well grounded that does not rest on them.*

102. Now begin an elaborate but essential series of tests to familiarize yourself with the tolerance of every part of the body from head to foot. This knowledge is indispensable. In a "general faradization" of an arm, the spine, a leg, or the whole body, you can torment a patient a good deal if you proceed with *few changes of dose*; but you can delight the tissues as by a song of gladness if you modulate your therapeutic tune to *harmony* with the parts. An artist in technique may make fifty alterations

in the rheostat while he is impressing his wishes upon the complex and varied tissues he is treating; a tyro has no ear for the finer strains of this therapeutic harmony and when he fails he does not comprehend the reason.

103. Next have an assistant make a labile application up and down your own spine. *Feel* the difference in the different muscle-grasps of different coils with all gradations of current-strength. Have the labile electrode moved not only over the central spine, but over the muscles of the entire back. Especially become acquainted with the actions of different *rates of change* and degrees of *pressure*. Note how tolerance is affected by movement of the electrode after the dosage has been developed to a maximum with the electrode still. As you test muscle contractions with the rapid and slow vibrators repeat for comparison the same tests with each coil and you can then afterwards select the proper coil for various cases.

In practice you will have much to do with spinal faradization and you cannot learn too much about it. Backaches are frequent and you can relieve nearly all of them with some shading of this technique. It is a luxury to patients when artistically done and will sound the praises of electricity round all your vicinage. Be not in too great a hurry to pass on to other tests. There is a great deal to learn about the back and what you can do to it with coil currents, and it is worthy of careful study. I once had a student taking instruction in all currents, but on the one technique of central galvanization he spent two weeks in careful mastery of details. He then came to me and with great glee said: "Why, doctor, I can do *stunts* on the spine now." There is the secret of success. Master every method until you can do "stunts" with it.

104. Next to the spine the normal arm is the most important region for faradic study. Here you need no assistant. I employ three variations of polar localization. In almost all cases in practice the active pole is the nega-

tive. In some cases I make the application *mono-polar* by placing the positive electrode under the spine, or by having the patient sit on it. Or I modify the current action by passing it *through the tissues* with the positive electrode on the arm and shifted opposite the negative, or above or below it. In still other cases I employ my sponge-covered bi-polar labile electrode, the poles of which are two and a half inches in diameter and an inch apart. Interesting effects are secured both on the arm and on the spine with this electrode, which I also use with the sinusoidal current.

You will first make mono-polar tests with the negative current and repeat them with the positive so that you will know *why* the *negative is the rule* with all interrupted currents employed to influence contractile fibres.

105. What I have said about *pressure* in the chapter on galvanic currents applies to faradic currents. First take a long coil and move the electrode over the forearm with the light contact of only its own weight. Increase the dose until pronounced action is felt and then observe the peculiar and agreeable sensation which this pressure limits almost to the skin. Gradually increase the pressure and note the effect on the *dose*! Can it possibly now be the same dose that a moment ago was simply thrilling the sensory nerves of the skin? Carry these tests of pressure through different coils and with all variations of the rapidly interrupted current. In conjunction read the remarks on galvanic pressures so that they need not be repeated in this chapter.

106. The study of motor points may conveniently come in here. Readers who have my book on the "Treatment of Diseases by Electric Currents" are familiar with my plain directions for finding them without a chart given in the chapter on "Electro-Diagnosis." Practice of this kind is essential when you encounter paralyzed arms which have diminished or lost faradic reaction. It will teach you where to place the electrode to affect the nu-

trition of affected muscles even when they fail to contract. A general knowledge of motor points is also essential for another reason. If you are making a labile application it will not do to sweep an electrode over a motor point with a dosage which has been adjusted to contract muscles elsewhere. Try it yourself on yourself and your future patients will be thankful.

107. Now let us test *rates of change*, not of the *current* but of the *electrode*, with a standardized dosage of medium *tetanizing* strength. Place the flat positive pad electrode under the thickest part of the forearm and hold the negative on the back of the wrist. The dose is adjusted so it does not hurt. If the wrist was sprained it would relieve the *pain*. The current will also act favorably upon the nutrition of the part. It exerts its beneficial physiological actions. But it is holding the *muscle fibres* in an *unrelaxed* grasp and this will shortly tire them. You do not wish to relieve a local pain in the wrist and leave the hand so heavy and exhausted that it cannot be used with comfort for several hours or days. Yet I have known eminent neurologists to do just this for want of knowing better. The principle of avoiding it is simple, *as are most of the foundation principles of rational electro-therapeutics.*

Unvaried work is monotonous. Even to *sit* in one position becomes monotonous. *Change* gives *relief. Slow* changes are not, however, *exercise. Quick, animated* changes are *restful* and *refreshing.* Sleep and recumbent rest refresh, but no kind of steadily maintained work is refreshing. In the application we are now making to the wrist nature demands some quick, refreshing change in the tetanized muscle fibres in order to rest them and restore buoyancy. A slow labile movement will not do this best. Lighten your pressure on the electrode about one-third and with quick strokes stir up the muscles of the whole forearm in a lively play of every fibre in every direction. In one minute take a new account of the arm and see how much of the fatigue is left. To know how to

dismiss your patients with a feeling of *refreshment* after any form of treatment is one of the valuable rewards of skill. The above principle has many applications which you should study, and the *opposite* of it is the principle of securing *sedation*. I make these very plain to my clinical students, and if my readers grasp the idea successfully they can develop it at their leisure.

108. It is important that the action of every electric current about the *head* should be fully studied. With both rapid and slow interruptions coil currents are applied to the throat, neck, sides of the face, eye, ear and frontal region and also to the mucous surfaces of the nose and throat.

The sensations produced by the various coils upon the forehead should be fully tested on yourself before attempting the treatment of any patient. This region has little soft padding between the bone and the skin, and the blows of a heavy current would strike the bone as if you struck your head against an unyielding rock. There is a peculiar *ache* that rapidly interrupted currents cause over boney surfaces by their tetanizing pull upon the attachments of the skin to the bone without the aid of yielding elastic muscle fibres to soften the tension. This ache limits the possible dose for special uses on the forehead and it is more intense with the Leyden jar current than it is with the faradic. It becomes severe with a strong galvanic current, and in this region every current should be increased from zero with careful caution to avoid distress.

109. Applications such as would be required in the treatment of facial paralysis may now be tested, with particular attention to the regulation of current-strength to different degrees of action. Unless the operator has enough ingenuity to work out a great variety of these applications it can hardly be considered that he has the bent of mind to fit him for this branch of medical practice.

110. I will now describe the most useful and satisfac-

tory method that can be applied to the mucous lining of the naso-pharynx. It is a method I have used for some years as part of my treatment of catarrhal conditions and it has pleased both patients and students to whom I have taught it.

Place the induction coil apparatus on a convenient table so that you will have at least a foot of table space in front of the battery. On this space stand a round crockery baking dish a foot across and with sides three inches high. In the center of this dish place a china bowl about four inches deep and five or six inches across at the top. Fill this bowl to the brim with tepid water, to which is added enough common salt to be neutral or stimulating to the mucous membrane as the case may need. At the side of the bowl have a small pitcher of the same solution. By means of one of the author's "sinkers" connect this bowl with the positive pole of the coil apparatus, thus making it a water-bath electrode.

To the negative pole connect an ordinary sponge-covered hand electrode, and sit in front of the apparatus so that you can easily reach the switches and also bend your face into the bowl.

Now comes the preliminary regulation of the dose. Switch into circuit the long fine coil, three cells and the rapid vibrator. Make contact in the left hand with the sponge electrode and tentatively increase the current from zero until it is a comfortable strength to the tip of the index finger when it is dipped into the bowl a half inch only.

Tuck a napkin or towel at the neck to protect the clothing from wet.

Now grasp the sponge electrode by the handle in the left hand and keep it for the moment in open circuit. Bend over the bowl so that the rim is in relation to the upper lip just below the nose. Next bend down the head so that the nose is as deeply in the water as you can comfortably get it. Snuff up the salt solution till it passes

round to the mouth, and with a little knack in the management of mouth-breathing the fluid can be kept in contact with the entire mucous membrane of the nasopharynx. Now quickly make contact with the right hand upon the sponge electrode and close the circuit. The current will now act upon the tissues and the dosage can receive its final adjustment. It should be just strong enough to sensibly grasp the anterior muscle fibres without discomfort. As soon as the tissues soak a moment and lose some of their resistance the current can be again advanced. Spit in the dish outside the bowl as often as comfort requires.

Hold the nose in the solution as long as you can keep the cavity full of it. Then do not at first lift the head. That would pinch the tip of the nose, as you have learned in the general study of water-bath electrodes. First, therefore, break the circuit by taking the right hand away from the sponge electrode, and then the nose can be lifted from the bowl to rest and breathe while the current is off.

After taking a fresh breath repeat the same process, but hold the contact longer. At the first trial it may be awkward to both breathe and retain the water at the same time, but it speedily becomes easy to keep the current in action for five minutes at a stretch. Some may sputter and gag over the first attempt, but I have had no patient who did not do well enough at the second sitting. Having used the method with satisfaction on children as well as adults, I regard it as a practical and useful technique with as few drawbacks as any of the methods of treating the same parts. The selection of the proper coil and the adjustment of the maximum dosage are two points for experience to determine; otherwise it is a simple method and only needs to be supported by other indicated measures to be very efficient and very satisfactory.

111. Passing from the upper to the lower part of the

body we should now study the reactions of the leg muscles and the tolerance of the tissues in different situations. First sit on the positive pad electrode while repeating upon the leg the same tests we have practiced on the arm and spine. Then make a sufficient series of tests with the stabile pad on the side of the thigh. Around the knee manipulate the electrodes in different relations to the knee and to each other. Also test the motor-point actions of the lower leg with the pad electrode placed under the foot, first anteriorly and next under the heel, as the action is somewhat modified by its situation.

112. Besides the actual requirements of dosage and choice of current in the treatment of the lower extremities there is also a great deal for the beginner to master in regard to the management of the patient. To get at all the various localities between the foot and the pelvis in both men and women with the least trouble and the least exposure is an art that is not acquired without experience. Make a series of practical experiments in which study the most convenient relation of the patient to the battery, the position of the patient during treatment, the adjustment of the patient's clothes, the easiest way to get at the part, your own position while directing the electrodes and the protection of the patient from either the wetting of undergarments or the unpleasant consequence of cold. I can hardly emphasize too much the importance of study of this kind for every part of the body that requires the removal of clothing. Learn when you can manage with merely the loosening of a garment without requesting the patient to take it off. Pay particular attention to the fine art of keeping undergarments from the saturation of a pad electrode. Never expose a patient to a draught of cold air during a seance. Learn not only to treat your patients with skill, but also to finish up the seance in a workmanlike manner. Have plenty of clean towels at hand, and not only dry the skin which the electrode wet, but apply to it the comfort of a little fine toilet

powder. After a spinal application, for instance, or a percutaneous treatment through the female pelvis, the woman who is dried and powdered at the close of the session will be far more grateful than she who is let depart without proper finishing attentions.

What I say here relates to all currents, and is especially important in gynecology, genito-urinary work, central galvanization, general faradization and applications to the trunk of the body.

113. Coil currents have uses as a means of abdominal massage, to affect the external muscles, to aid intestinal peristalsis, relieve pain and for sundry other purposes. To rightly appreciate the action of the different coils and different rates of change it is absolutely necessary to test them on yourself. Now is the time to do it. Place the usual pad electrode under the lumbar region if you lie on a table, or sit on it if you place yourself on a stool in front of the battery. Personal tests can be made as well one way as the other.

The choice of the active electrode in practice will vary with the intent of its use, hence you must become familiar with the reactions through at least three sizes of electrodes; all covered with thick tough sponge; all to be well wet in hot water and well lathered with soap. One of these electrodes should be a small round ball for use with deep pressure in certain regions, for instance, the gall bladder; another should be 2x3 inches in area; while the third may be one of the common round sponge electrodes which all dealers furnish with faradic batteries.

Your personal experiments should include:

Tests *stabile* with all degrees of pressure.

Tests of the action of each coil.

Tests for tolerance in different parts.

Location of motor points.

Actions of slow interrupter with rates from 60 to 300 per minute.

Actions of rapid vibrator.

Stabile applications with maximum dosage over different visceral organs.

Labile tests over the colons.

Deep pressure tests aiming to influence the stomach, gall bladder and kidneys.

114. Then secure three patients who present marked contrasts in respect to *embonpoint.* Unless you have done this before you treat cases in actual practice you will not be prepared for the tremendous difference it makes whether the abdomen is thick or thin. Make your advance tests upon a case of marked emaciation and note the visible play of the muscle bands which respond to every action of the current. It is a beautiful demonstration. Note how deeply and surely you can attack the large and small intestines. The current penetrates everywhere. Tolerance is perfectly easy.

Now take the medium case of an abdomen muscular, well-shaped, not obese, but paded with enough fat to fill in the hollows. Note the difference in the *tension* of the skin. The muscle fibres do not display their action to the eye. The movements are more *en masse.* Deep action is less pronounced. Note that to get the same excursion of the rectus or oblique muscles that before was easy you must now use much greater current-strength.

Last take the moderately obese abdomen. It is not necessary to seek out a case who is very fat, for it does not take much of this non-conducting (or poor conducting) material to hamper the action of the faradic current considerably. Take then a moderately fat man with tense skin and try to secure on him the same actions with the same current that in the first instance gave you such a wonderful illustration of massage effects. See how difficult it is to even approach some of these actions without forcing the dose beyond the comfort of the tissues. It is an object-lesson of great significance.

Read also what I say in the sinusoidal chapter on

abdominal applications and profit by the suggestions therein.

115. From the male abdomen it is a short cut to the *rectum*. In the male urethra the faradic current is seldom indicated, but in the parts that can be reached through the rectum it may be made to do excellent and skilled work. One method of application is wholly above the sphincter ani and aims to affect the nerve supply, blood vessels and muscle fibres of the parts in internal relation to the sexual organs. We will consider this method first.

For purposes of study put the patient in the gynecological position with a pad electrode under the sacrum, or, in actual practice, as much higher as may be needed in the given case. Have a good light on the parts so that you can note every shade of muscular action. Lubricate the author's "prostatic" electrode and insert it in the rectum till it just slips beyond the sphincter. Now connect both electrodes with the battery and at first make the internal one negative.

Begin with the long fine coil and proceed down the series till you find the coil that gives you the proper localization of action. In a case of congested or inflamed prostate the sedative dosage required would select the coil, but in this test we will aim simply at tonic and vascular effects. We therefore find the medium and short 32 wire coils the two sizes of best local action.

Gradually increase the current from zero until you can *feel* a commencing pull on the electrode and *see* the first retraction of the external muscles around the rectum. Increase the current very slowly and ask your usual questions of the patient. The pull will grow stronger on the electrode and you can see the further retraction of the external muscles. At a point which you must learn by experience the strong grasp of the current hitherto agreeable will reach the limit of the author's *elastic contractility* and the peculiar ache of the over-strain on the attachments will appear. It is an ache that cannot be de-

scribed; it must be felt. When you have set up this ache you have gone just beyond the range of therapeutic dosage and will now reduce the current the single point that will restore comfort. Once you have mastered this guide to accurate dose regulation you need rarely ask a question of a patient.

In my own clinic I have demonstrated to a physician the easy facility of thus bringing the current-strength to within a single notch of the rheostat below the warning ache before asking the patient as to his sensations. It is a neat protection against the liability of hurting a person for want of knowing when to stop.

116. Having practiced the principle of accurate dose regulation it is next in order to learn how to make the dosage *effective* on the tissues that need it. Pull on the electrode till the bulb of it is drawn down to just inside the sphincter and make the current strong. By the opposing action of the thumb and index finger press the bulb of the electrode firmly upward against the tissues. Then slowly push it forward till the patient reports that he feels its action extending clear to the end of the penis. Test all degrees of insertion, from the anus to above the prostate, and obtain reports from the patient as to the seat of greatest action all along. The patient can indicate when the current is exerting its tonic influence upon the verumontanum, but the anatomical knowledge of the operator must locate it against the prostate as desired. Make various tests with it in different positions and with different degrees of dosage for different effects. Note that the action of the slow interrupter is not suited to the tissues of these parts, but that a beneficial slow contraction and relaxation is obtained by intermitting the rapid vibrator with the tip of one cord. The *swelling* method is also useful and should now be practiced.

Those who have but vague ideas as to the possible benefits of coil currents in this location should refresh their

memories by reading the chapter on the physiological actions of induction coil currents in my larger text-book.

117. Now leave the patient in the same position with the pad under the sacrum, and insert the smallest of the three sizes of standard rectal electrodes. Study the effects upon muscle fibres and nerves of sensation with all the various coils and the dosage they will permit. Practice all variations of rapid and slow interruption, and the swelling method. Change to the larger sizes, which will add mechanical dilation to the action of the current, and carefully study the uses of a very important but much neglected therapeutic resource. *Attempts at this work should not be made with a coarse and inferior current.* The right quality of current is as grateful to the tissues as drink in the desert, but, judging from the printed remarks of some of the rectal specialists, I fear they have not practiced the discretion of using a fine current. They say electricity in the rectum hurts. I must believe that *they* make it hurt their patients, but I don't hurt mine. I make an electric current in the rectum as soothing to pain and as comforting to states of vascular derangements and local irritability as the gentle stroking of affection on a tired brow. No other agent can compare with it for the relief of rectal pains of many kinds if it is rationally used and not abused by ignorance. I have seen a single treatment with electricity remove a pruritus of the anus that was holding the patient in torment in spite of 'salves"; I have had a single treatment afford the patient "the first painless stool she had had for eighteen years"; I have known a single treatment to restore comfort and control of the sphincter so that the woman "could assist herself at stool for the first time in seventeen years"; I have seen patients cease to complain of very painful hemorrhoids after a few treatments of the rectal tissues with the soothing actions of the right currents; I have seen patient after patient shrink with pain during the most gentle insertion of a warmed and lubricated electrode, and in almost a

moment become entirely comfortable as the high frequency *sedation* controlled and banished the pain. These are the commonplace results of ordinary experience. There *are* conditions in the rectum beyond the reach of electro-therapeutics, but so far as the pathology indicates the local action of any current it is as beneficial to the tissues about the lower rectum as to any other part of the body. The only qualification is that it shall be applied with skill.

118. The external male genital organs come in for their share of the benefits of induction coil currents. The difficulty is getting at them with perfect contact. This difficulty is solved by the water-bath electrode as demonstrated in my clinics and taught in my book on "The Treatment of Disease by Electric Currents."

Procure a neat bentwood chair standing 22 inches high. On the upper leg-brace of this chair, which is about four inches below the seat, fit a small board so that you can clamp it fast or remove it at will. On this board and under the organs stand a dish to catch the drip from the genital electrode. Let the patient drop his trousers to his feet and sit on this chair, with his knees apart. Put the pad electrode on the lumbar region and press it to firm contact by means of a pillow. In a china dish of the right size filled with warm water drop one of the author's indispensable "sinkers" and in this electrode immerse the testicles and penis to the bottom. Keep them well covered by pressure of the patient's thumb, and keep the dish full by adding water if any spills out.

Now make all the usual tests of current action. The rapid interrupter and the short 32 coils are the features of chief importance to study. The swelling method is also useful, but needs to be done with moderation. The testicles obviously get the best of the contact, and hence get the best results of the current when the penis and testicles are placed in the same dish. To localize all the action upon the penis alone needs only the extension of

the principle of the water-bath electrode to that redoubtable organ. For this purpose I use a neatly finished wide-mouthed glass bottle such as the best city dairies use for their best cream. The sinker is dropped to the bottom and it is at once an admirable electrode.

Get any suitable bottle and make the usual experiments until you are an adept in the art of developing a shrunken penis to the full standard of masculine pride and power. I do not mean to say that any "faradic" current will do this. There are so many poor faradic batteries outstanding in this country that I cannot vouch for all of them, but it is safe to say that with the combined resources of coil and galvanic currents the skilled physician can help all cases that are still in the curable stage. My new sinusoidal apparatus provides me with a current which is even better.

Of course, this is only a part of the full treatment required by cases of various grades of impotence. I conquer such cases with patience and often much labor when they are very chronic, but no one method is a cure-all.

119. Closely related to this field of current action is the important method of *vaginal bi-polar faradization*, the most distinctive and special use of high-tension induction coil currents. Before venturing on uncertain ground with new patients assure two or three old patients of the dispensary class that you will not hurt them and obtain their aid in your initial efforts to become expert.

Place one of them on the table as if for a digital examination of the uterus. Warm and lubricate the electrode and connect the tip with the positive pole—*always*. There is no exception to this rule. Use no speculum. Take the end of the electrode in the right hand and insert the index finger of the left into the vagina to note if the rectum be properly empty and to tentatively test the tenderness. Also note the position of the uterus and the location of the cervix. Now withdraw the finger and as it gets nearly

out insert the electrode in the same place. When the electrode is entirely inside so that the metal parts are wholly internal to the tissues of the vulva direct it in the median line and gently pushed to the cul-de-sac of the cavity. Keep the current entirely shut off as yet. Pry the electrode around a little and ask the patient in regard to the sensation of the instrument without the current.

When you have satisfied yourself that all is ready you may start into action the longest coil and the rapid vibrator, with a safe E. M. F. of two cells. She probably will not feel this current at all, but better so than to have her become afraid of being hurt. Ask her to speak when she feels the first sensation of the current, and then increase the strength until she says she feels it. Note the record of the switch-board so that you can reproduce the same dose and afterwards take the electrode in your hand and compare the same current on external tissues. The reason that the dry, thick, *resisting* skin of the hand feels the current so much is that is it *localized.* The action is spent *upon a small area.* The reason the vaginal tissues feel the current so little is that *the absence of resistance* enables the voltage to *diffuse the amperage through all the soft and moist parts of the pelvis* and the great area of action attenuates its density.

120. Test the dosage of initial sensation in the vagina with each coil, as they differ decidedly in their *localization.* Then test the cautious development of the maximum dosage with each coil, and also note how much the tolerance can be increased *after* you have acquired more *skill.* The beginner is never able to get the same work out of currents that the trained operator can. But it is necessary for you to learn by practical experience what a fair maximum dosage ought to be or else you will waste half your time in wholly inadequate applications. All new patients in the hands of a novice aim to keep on the safe side, and to avoid what they *think* is going to hurt them they will manage to keep the dosage down as low as they can. The

expert quickly gets past this trouble and runs up the current to what he *knows* is needed to be effective.

121. Now drop the dose of the coil in use to an easy tolerance and study the diversions of the current action when you deflect the electrode from the proper position and the median line. Press it tentatively to the right and to the left, forward and backward, and in all directions. Note that you can tease the bladder, the rectum and the muscles of the thigh, and that the comfort of the moderate dose gives place to intolerance in a greater or less degree when the electrode is anywhere but where it properly belongs. Before any efficient therapeutics can be developed by this method the art of *directing the electrode* must be fully mastered. When you know how it should be done you can then have the patient do it herself by means of the author's *handle*, devised originally by me in 1894 and since greatly improved in shape, size and convenience. Its use saves the entire need of your personal attention to the electrode during treatment, which was formerly the only objection to this valuable technique.

122. Having learned the elementary handling of the electrode and the range of dosage, we may next practice the variations in effect that can be produced by variations in the manner of the administration. These shadings of effect depend on alterations in the *rate of change*, and if I have succeeded in making the principles governing rate of change clear the reader is fully prepared to produce any effect that he desires.

It is true that the rapid vibrator is alone used, but by certain manipulations of the current we make the action tonic, stimulating, sedative and all degrees of these effects, or act upon the vascularity, or nerves, or muscle fibres, according as the case needs. The *principle* is the same as taught throughout this manual that slow rates of change allay excitability, while quick disturbance of parts will tend to wake them up to greater functional

action. The different managements of a mother in putting a child to sleep or waking it up expresses the idea exactly.

123. For sedative effects within the vagina test the restful method of slowly coaxing the current up to tolerance and then letting it slowly die away. You have aimed at *sleep* and therefore do not rouse the tissues at the end by any quick alteration of the current, not even by shutting it off quickly.

But for a more tonic action the principle is one of *gentle exercise*, and you now more strongly urge on the current and keep it near its maximum instead of letting it die away. Make these tests and have your patients describe in full the different impressions you make on the tissues by every change you insert into the technique.

124. But remember that "sedative" effects in the therapeutic sense cannot be produced on normal tissues. You cannot reduce a fever with aconite if the baby has no fever, and to really obtain sedative actions by bi-polar faradization the patient must present the essential pathological state.

125. Now test the quicker *rates of change* that are adapted to whipping up the pelvic circulation and nerves and muscle fibres and stimulating the parts.

When this action is indicated the tolerance calls for a more energetic dose, which is kept at the maximum during a short seance. A few swelling intensities at the end vitalizes the effect.

Bi-polar faradization is so important a technique that every physician should perfect himself in every detail of its management. The indications for it and the wide range of its usefulness are set forth at length in my book on "The Treatment of Disease by Electric Currents." In the same volume readers will find directions for the uses of all currents in gynecology.

126. A mono-polar electrode in the vagina also has its uses in practice. A pad electrode is placed under the

sacrum. The adjustment of the dosage follows the same rules as *bi-polar*, but the localization is somewhat different. Study of technique will include tests of each pole and variations in the situation of the active electrode. Fix in your mind as you go along the particular coil that gives the approximate dosage for the major actions in different cases, and master the management of all switches so that patients will never be made nervous by your lack of care and will never dread lest they be hurt by some unexpected move.

127. All the foregoing and hundreds of other clinical experiments the author has made in the development of his present skill. It is assumed that the physician who is in earnest in the same search for knowledge will be fitted by the practice of what I have here described to set about such other tests as the needs of his own patients may require. The trained expert is the product of several years of persistent and intelligent work along the lines here laid down. He is not made in a day by the purchase of elaborate apparatus, and there is no "royal road to learning."

But, every student will ask, when are these methods to be used? When shall I select this technique or that technique for the treatment of a patient? In what cases shall I use the negative pole and in what cases the positive?

These and scores of other questions will be asked by the helpless novice with a new battery and without instruction. There are two answers to them. One is that the rational principles of electro-therapeutic application will gradually (as you master them) teach you when to apply any method of technique, for methods are but the agencies by which you make the currents produce effects, and the general medical knowledge of the physician ought to inform him what medical effects he needs to prescribe in a given case. You will need certain actions in electro-therapeutic treatment exactly when you would

need similar actions from drugs, if drugs would furnish them. You prescribe drug action and electric-current action for the same reasons, and on the same principles of meeting the indications of the diagnosis, and technique is your means of creating the actions you wish a given current to have when you prescribe it.

On the other hand, the answer to these questions is carefully laid out for you in the seventy chapters of my book on "Treatment," and it is only necessary to study it in connection with the test practice of this manual to find the answer to almost any question the novice may ask.

It is expected that the reader will study galvanic and sinusoidal hints while he is practising with faradic methods, for there are many points of common application and some have greater prominence in one chapter than another.

Let me finally suggest that if you use a faradic battery, get a good one. Poor batteries are delusively cheap. They betray your confidence and deceive your patients. They price of the best is reasonably small, and none but high-grade faradic batteries are fit for any therapeutic use except gross muscle stimulation. Regard for *quality* in his professional work should decide the physician to use a proper tool if he uses any.

CHAPTER III.

STUDIES IN SINUSOIDAL TECHNIQUE.

Sinusoidal Currents Explained.—Systematic Tests for Clinical Uses.—Author's Methods.—Scientific Dose Regulation.—Place of Sinusoidal Currents in Electro-Therapeutics.—A Series of Indispensable Home-Clinics.

Sinusoidal technique parallels that of induction coil and Leyden jar currents, but furnishes effects and permits refinements in administration that are not exactly duplicated by other means. I have two varieties of sinusoidal apparatus, each so different from the other in their relations of amperage to voltage that they occupy therapeutic fields almost as distinct as quinine and mercury.

The earlier apparatus furnishes me an ideal current within an exceedingly narrow range of dosage. It is exquisite when needed; fine and smooth and most gratifying in local states of great tenderness, pain, congestion, or inflammation. But in the average run of office cases in private practice its value is chiefly in this particular field. The *range of dosage* and utility of my high-tension coil apparatus is greater, although when the case fits it the delicacy and quality of the sinusoidal is unique. I should not like to be without it.

Early this year (1900), however, I added to my equipment a sinusoidal machine of quite a different type. *It supplements all my other currents and displaces none.* Each coil of the faradic has its place, the galvanic has its place, and each sinusoidal has its best particular uses. I would not part with any one of these resources in electro-ther-

apeutics, but would rather add to them as my experience develops.

128. A simple comparison will suggest something of the *differences in quality* imparted to these currents by low, medium and higher voltage. In a general and perhaps inexact way it may be said that it is the function of *voltage* to put the *amperage* of the current into the place in the tissues where we wish it to exert its *local* action. Of course, there is action along the entire route traversed between the electrodes, but the area of maximum action depends upon the pressure force—the voltage—of the current.

Take, therefore, two small foot tubs and draw six inches of warm water in each. Add a teaspoonful of bicarbonate of soda. Remove the shoes and stockings and put a foot in each tub. Connect the tubs first with the low voltage and fine sinusoidal current, one pole in each tub by means of the author's "sinkers." At the maximum of comfortable tolerance the contractions of the current will grasp the *feet.*

Then connect with the sinusoidal apparatus which generates the larger current and the "grasp" will be around the *ankles* appreciably higher than before. Now transfer the cords to the Leyden jar current and the greater push of the higher voltage will drive the wave of vaso-motor constriction along the tissues and *up the legs* to the gastrocnemeii. The patient will state that he feels it in the "calves of his legs," or even to his knees.

Much of your confusion and doubt in selecting the proper current for a given case will be cleared away in your mind by the study of these differences of action with the same technique.

129. At this point perhaps many of my readers who have not yet had acquaintance with this form and quality of current will appreciate a brief and clear explanation of what it is. The therapeutic current to which the *sine* wave has lent its name is practically an induction coil

current quite similar to the other induction coil currents which are called after the immortal Faraday, but with all the sharp angles smoothed off by the mechanical device of the *make and break*. It is a machine of one secondary coil instead of a set of coils.

130. The "Edison Therapeutic Sinusoidal Alternator" has all its fine wire windings connected in one series for the secondary coil. Instead of a spring vibrator to furnish the rapid interruptions of the current they are produced by a break wheel motor which drives the armature. The continuous *primary* exciting current is then transformed into *secondary* alternating current waves which are "sinusoidal" in their regularity of rise and fall. Tie a long clothes line to a post, hold the other end a little slack and give it one impulse and you will see a *sine* wave of undulations travel along the line. With more slack the waves will be fuller.

A strictly scientific description would vary somewhat from this, but the ordinary practitioner would not understand it so well. What I have said will convey a fair idea of the kind of current it is and that is sufficient for my purpose.

The motor is usually (and best) run by the direct street current, and by means of a rheostat its speed is varied from a few hundred to 115,000 periods per minute. Four resistance lamps divide the rheostat into four steps, or rates of speed. Readers of this book will easily select the rates of "frequency" which are the most useful.

What corresponds to the "primary" in the familiar faradic battery is actuated also by the street current cut down by a lamp rheostat. The *secondary* current only is applied to patients and is regulated in strength by a water rheostat connected in *shunt*.

The actual therapeutic voltage in the treatment of patients is under 20 volts, and the fine wire of the coil restricts the amperage to a small volume. Hence the ad-

vantage of the galvano-sinusoidal combined current referred to in the succeeding chapter.

It has been said that the poles of this apparatus are *alike*, but a single moment's test will demonstrate that one will produce a stronger muscular contraction than the other. Try it yourself.

131. The "McIntosh improved sinusoidal apparatus" also has a small motor run by the direct street current, controlled by a graphite rheostat. The therapeutic secondary coil current is a *magneto*-induced current instead of a *galvano*-induced current such as you are familiar with in the faradic battery. The dosage is regulated by a second graphite rheostat. The base contains a switch with two arms. When these arms are on the button marked "A" the patient receives an *alternating* current. When moved to the button marked "D" the current is all delivered in *one direction* and is in effect a rapidly interrupted *galvanic* current with a moderate voltage and a fluctuating amperage, varying in intensity during each revolution of the armature carrying the coils. The maximum is about 3 or 4 mil. The E. M. F. of the patient's circuit with both currents of this apparatus increases in proportion to the speed of the motor. On a metal circuit the E. M. F. can be made to range from 33 to 110 volts, but with the resistance of the patient in treatment the voltage falls to a great deal less.

Slow interruptions of from 100 to 150 are also possible, and the limit of motor speed is 12,000 periods per minute.

132. The *physiological actions* of this type of current should be studied before commencing the practice of *technique*, for a physician should know what his remedy can be made to do ere he attempts its administration. These medical actions have been briefly outlined in several short articles on sinusoidal currents, but the reader will obtain a much more accurate comprehension of the subject in its entirety by regarding the therapeutics of the sinusoidal current as modifying and combining the physiological

actions of both "high frequency" and "high tension" coil currents, with some difference in quality, but acting on the same lines. Except as to voltage there is also close similarity to the smallest Leyden jar current. The *three chapters* on the physiological actions of these currents should therefore be studied *together* and blended into a fair idea of sinusoidal work. This does not mean that the one current will equal the other three. By no possibility of skill can any one current be made to exactly duplicate any other; but I mean that the sinusoidal current supplements the other induction currents by important modifications and shadings in effects. It makes an adjustment of dosage more accurate to be able to modify certain major actions at will to suit the case and therefore each variety of induction current is a needed addition to our armamentarium and not a substiute for something else.

Far too many physicians obtain the mistaken idea that one current is the whole of electro-therapeutics, and that if they ask which is the best to buy and buy it then any other battery would simply parallel what they have and would be superfluous. You could not make a greater error.

133. Let us now begin the practice of sinusoidal technique. Of the many ways in which action and dosage should be studied during the period of acquiring skill the following are of first importance:

Bi-polar and mono-polar arm bath and foot bath technique.

Labile applications to arm and leg muscles.

Labile applications to the spine, both mono-polar and bi-polar.

Stabile and labile actions upon the abdomen.

Stabile and labile technique upon and about the male perineum.

Vaginal bi-polar effects.

We are to test these with every possible dosage and with both the alternating and direct current, but let us

master the important general principles before engaging in local work.

134. Among the first things to test and become familiar with are the alterations of current action produced by *variable pressures upon the electrode*, by *size* of the electrode, by different *rates of interruption* from the slowest to the most rapid, by different rates of *increasing* and *decreasing* the *current-strength*, and by different *rates of moving the electrode* in labile applications. These are fundamental, and the future expertness of the operator will be closely related to the amount of care with which he early masters these elements of technique.

I may say here in passing that just such tests as these, repeated over and over again with every type of current in my office, comparing each with each, noting resemblances of action and differences of action, have done more to develop my own skill in technique and confidence in my choice of current than all other procedures put together. There is no royal road to skill, but there is a very direct and short road opened before you in the pages of this manual.

135. One of the marked distinctions between sinusoidal and coil currents appears on the following test: Take two medium-sized sponge-covered electrodes wet with warm water. Connect them with an 800-yard No. 32 coil, or any length of any size coil current, rapidly interrupted. Touch each sponge very lightly with three fingers. Increase the current gradually until it is plainly felt. Now raise first one finger and then the other, and note how the lesser area of contact increases the density of the current and appears to intensify the dosage.

Now restore the three fingers to contact and gradually increase pressure. Note how the firm pressure reduces the sensory effect of the light touch. Vary the dosage and coil and test it in every way. Note that with a high voltage coil and with the Leyden jar current similarly dosed you get a thin spark discharge as the finger ap-

proaches the electrode. The current has sufficient voltage to jump through an air gap of a small fraction of an inch just before actual contact is made. This does not occur with low voltage currents, either from faradic coils or sinusoidal machines.

Now connect the same electrodes with the rapidly interrupted sinusoidal current and note that no sensation or action occurs on *light contact* with a small dosage, but the same dosage contracts the muscles firmly on *deep pressure*. Change the contact to one, two and three fingers and note that the effect does not alter as it did with the coil currents last tested. The difference between light and deep pressure in the actions of sinusoidal and other currents is important during treatment when the technique involves lifting the electrode and replacing it without stopping the current. The fact that the sinusoidal current does not spark the operator's hand through thinly insulated cords and electrode handles when the circuit is broken is due to its low voltage, which makes it a very comfortable current to employ, and all know how unpleasant the high voltage Leyden jar current becomes under the same circumstances.

I have elaborated this test in detail in order to impress upon the mind the *reversed* actions under light pressures and imperfect contacts of the sinusoidal and faradic currents. But you note that with the newer sinusoidal current there is a large and powerful grasp upon the muscles even with a comparatively small dosage. This is due to its relatively great proportion of amperage.

136. We will now proceed to take up our local tests in regular order. Prepare the author's bi-polar arm-bath electrode with plain warm water. Place the arm in it so that two inches of water are between the elbow and the metallic conductor, and an equal space between the hand and the other metal plate. Test all variations of the current with the arm simply resting on the floor of the tub. Vary the rate from the slowest to the most rapid, and

test the entire range of current-strength. Then select about the medium dosage and turn the forearm on edge, also flexors down; next extensors down. Close and open the fist. Close and open the fingers one at a time. Then spread them apart and move them nearer and nearer to the metallic contact. Note that *touching* the metal electrode does not produce any "shock."

137. Next partly raise the arm from the water and again fully immerse it. Note all the fine shadings of local and muscular action that can be differentiated by these maneuvres. Then release one cord tip from the metal plate of the tub and attach it to the author's "paddle" electrode with long insulating handle. Immerse the paddle in the water and test labile actions on muscles while moving along the forearm with an inch of water between the electrode and the tissues, and next with actual contact. Note how much current is required to produce different degrees of flexion and extension, and how differently a quick and a slow movement acts on the muscles when the strength of current is the same.

138. Next return the cord tip to the tub and resume the stabile bi-polar bath administration. Adjust dosage to full tolerance and add two quarts of hot water, noting how the increased area of contact attenuates the current and like a little butter spread over a larger slice of bread reduces the *density* of the dosage. Then dip out an inch, two inches, three inches of the water and note how *intensity* rises as the *level of contact* falls. Then return the full level of water and the maximum dosage and slowly stir in ten grains, twenty grains, a little more, and more, and finally, a full teaspoonful of bicarbonate of soda. Will the current now be stronger or weaker? The test answers the question for all time. The increased conductivity of the water now carries more and more of the current *around* the arm and less *through* it, so that the previously strong dosage will now be scarcely felt. You have made the water a better conductor than the arm and the cur-

rent very nearly short-circuits. This teaches that plain water which has a higher resistance than the tissues is required for the bi-polar bath treatment.

139. In concluding a seance of this kind in private practice reduce the current to zero, lift the arm out of the water, keep it over the tub, dash cold water over it the instant it leaves the hot, and then dry and powder it. This finish leaves the arm as light and buoyant as if "made over new." In certain atrophic conditions this technique is one of the most valuable in the whole range of electro-therapeutics and is in constant use in my practice. The author's arm tub is as essential a part also of a static machine equipment as is the spark electrode itself.

140. Now here comes an apparent contradiction for the novice. The use of the same tub, same electrodes and same current as a mono-polar arm-bath reverses the conditions so that bicarbonate of soda is essential. To demonstrate, place about two inches of warm water in the same tub and add a half dram of the alkali. Connect one end of the tub with the battery and let the forearm rest in the water with the hand an inch back from the metal plate and all the arm above the elbow out of the water.

Connect a wet and soaped hand electrode to the other post of the battery and apply it to the deltoid muscle. While slowly increasing the current from zero move the electrode with even pressure to the various muscles of the arm and shoulder, and observe the degree and quality of action that increases as the current increases.

141. Vary the *rate of change* of the labile electrode from slow to quick and note the alteration in muscular effects that follows. Remember the principle of dose regulation according to the elasticity of contraction and you will not be obliged to ask the patient if the current is "too strong."

142. Then adjust a maximum dosage and remove one

cord tip from the battery. Hold the tip in the free hand and touch it to the post of the battery so that you test variations of action according to the relation of make and break. Also vary the current-strength and note how the tolerance alters according to the *frequency* and *duration* of contact.

143. The object of immersing the forearm and hand in this technique is readily seen. It affords a general and complete distribution of the current through all the tissues, with advantages that can be obtained in no other way.

Study every possible alteration of the rate of change as influenced by the speed of the motor. Learn to know what impressions upon tissues are made by very slow rates, and by all speeds up to the maximum, so that your selection of the current will be followed by a competent adjustment of the interrupter and current-strength, as well as by the correct pressure and rate of change of the electrode. Let no details of accuracy escape.

144. Now place the feet in a bi-polar footbath in the center of the tub with several inches of water between the outer sides of the feet and the metal plates of the opposite poles. Should the water now be plain or alkaline? If you have forgotten, refer to your preceding test on the arm. Certainly the resistance of the water must be greater than the resistance of the tissues or no *treatment* will reach the feet at all. If the water was the best conductor the current would flow round it and ignore the feet.

In plain water therefore immerse them and increase the current to a point which other tests of this apparatus lead you to think should be strongly felt. You find, however, that you scarcely feel it at all with the feet standing together in the middle of the tub. But now slowly spread the feet apart. As they separate the water resistance increases between them, while the resistance between each foot and the side electrodes decreases. The re-

sult is an increase of current through the feet which gets stronger and stronger, till each foot touches the plate and is in metallic contact with its pole. If you now add bicarbonate of soda the action of the current loses force upon the tissues and short circuits through the bath.

A few experiments will teach that this method of technique has great advantages over the direct application of ordinary electrodes, but gives place in practice to immensely superior advantages obtained by placing each foot in a separate tub.

145. Take two small foot tubs, draw in each enough warm water to cover the ankles, add the usual bicarbonate of soda and place them side by side, but a few inches apart, in front of the apparatus.

Next take a pair of the author's "sinkers," connect them with the binding posts and drop a sinker into each tub. Sit on an easy chair with the feet in the tubs and in practice throw a suitable cloth or light blanket over the patient's knees to protect from draft and from exposure.

Increase the current *quickly* from zero to a firm grasp on the muscles. Wait a minute and see how the action loses its initial sharpness and becomes more mild as the skin soaks with water and the current diffuses better. Then *slowly* increase till it flexes the toes—then reduce. Study the points of tolerance. From full tolerance cut out the current *quickly* and note how it feels. Would the average patient like it? Or would she prefer an *even and slow reduction* of current-strength? It is probable that what you find most pleasurable yourself will please patients best and the information you gain in these tests is absolutely invaluable on that account. Tests on yourself will answer almost every question you need to ask about methods and degrees of dose regulation. My other books will help you to the therapeutic applications.

146. Now "swell" the current, and then test slow interruptions made with one tip by hand. Also shift the sinkers in the water from near the heel to the arch and

again to the toes and learn the local modifications that result from different positions of each sinker.

147. Test also different levels of water in each tub so that if but one foot requires active treatment you will know how to release the other from tension by variations in the quantity of water.

Particularly note the sharp sensation that will prevent the use of an efficient dosage if a crack in the skin between the toes, a troublesome corn, or an eruption breaks down the resistance of the normal epidermis. The complaint of the patient at a *mild* stage of the dosage should lead to an examination for the *cause* of trouble, for granted an unbroken skin the seance should be as restful and enjoyable as it is beneficial.

148. It will now be seen that this important technique combines the following advantages:

1. The therapeutics of the hot footbath succeeded by the tonic action of the cold douche at the end.

2. The softening and sedative-tonic addition of either salt, or bicarbonate of soda, or ammonia, to the bath.

3. The therapeutics of the selected electric current, which must traverse both legs and the lower spine in order to complete the circuit.

4. The adjustable flexibility of the area of contact by making the depth of water suit the case.

It is adapted to a variety of conditions affecting the lower extremities or local in the feet. Its value depends on the operator's skill in dose regulation and his choice of currents. Employed with the common faradic battery it would be worth little. The *constant* galvanic current is also rarely indicated. The *interrupted* galvanic can be used for a few purposes. High tension induction coil currents have limitations which make them inferior to the large work demanded of this technique. The sinusoidal current of not only low voltage, but very small amperage has certain uses in conditions which require an exquisite and comforting sedative, but the relief of pain, the effects

upon circulation and nutrition, nerve fibres and muscles, and the complex actions of the Leyden jar and the *larger** sinusoidal currents give special prominence to this fine resource of electro-therapeutics. Test both of these currents with all gradations of dosage and begin with the sinusoidal as described above.

149. Next experiment upon your arm. Place the stabile pad electrode on a stool and sit on it, leaving one hand to operate the labile electrode and the other to regulate the current. My favorite electrodes for arms and ordinary labile use have a carbon base about two inches wide and three inches long, a half inch thick, flat top and bottom, oval around the edge, and covered with thick tough sponge. The handles made for me are of thick, hard rubber, giving perfect insulation with all currents.

Prepare one of these electrodes as usual with hot water and soap, and place it first on the extensor surface of the forearm, which should rest palm downward upon a convenient table within easy reach of your switchboard. Let the electrode simply *touch* the skin and increase the rapidly interrupted current from zero till it contracts at least one muscle. With this "strength" of current unchanged next increase the *pressure* upon the electrode, and as it presses deeper and deeper into the tissues note how the current increases its action on the deeper muscles. This demonstrates that the true "dosage" involves much more than mere "strength of current." The object-lesson is very important as a guide to adjusting your future technique to definite ends.

If I succeed in this manual in teaching my readers nothing more than the relation of *pressure upon the electrode* to the *action* of the current and to *clinical results* it will be worth far more than the cost of the instruction.

150. Next practice short and slow sweeps of the labile

*McIntosh apparatus.

electrode over the extensor surface of the forearm. Test all gradations of current-strength till the contraction passes beyond the limit of elasticity and reaches that tense *thump* and tetanus which I have taught defines the excess of therapeutic action.

151. Next test the effects of quicker and longer sweeps over the motor points. Test the action on muscles adjacent to motor points, but not on them. Test the "swelling" current. Test slow, fast and varied single breaks of the current made with the hand holding one cord tip, while the commutator is revolving rapidly. Test all rates of the commutator and note how *intensity* of current action is proportioned to the *rate* with this apparatus.

152. Extend the labile application to the flexors of the forearm—to the hand—to the inner surface of the arm—to the axilla—to the pectoral and shoulder muscles and as far as you can reach. Note the differences in resistance of different parts of the arm, in part due to thickness of skin and in part to nearness of nerves. Note that the differences in excitability of different parts of the arm are so great that an attempt to produce *equally distributed action* upon the different groups of muscles calls for frequent manipulation of the rheostat and an expert knowledge of technique.

153. In making these tests note how far you can push the contraction of any muscle before reaching the limit of physiological *elasticity* and setting up fatigue or pain. Especially test the difference between having well-padded soft parts under the electrode and having little save skin between the electrode and the bone.

Study the relation of current-strength and the management of the electrode to *causing* pain, *avoiding* pain and *relieving* pain. Neglect nothing in electro-therapeutics that relates to pain, for in the various currents you have the most potent remedy in the world for most of the sufferings of chronic disease if you will but learn how to use them.

154 Also observe how you may while a novice leave an arm limp, heavy and fatigued—almost powerless, requiring hours or days to recover—and how by better skill you can, in a single minute, with the same current, same dosage, same polarity, same electrode, same everything but *pressure* and *rate of change* whip up the tired muscles, infuse into them the energy of new life and leave them light, elastic and refreshed.

155. The *chief object* of a local treatment may often require an action of the current which temporarily tires the local muscle fibres, but the most elementary skill will teach you not to hereafter *dismiss* them tired, but to refresh them as you close the seance. I have instructed my pupils to do this with all currents—galvanic, faradic, sinusoidal and static—but so few seem to be aware that it can be done that I presume the peculiar technique required to do it is original with me.

Neurologists especially seem to need this knack, as they deal much with pain and paralysis, and patients treated by them frequently have their *muscles* punished for the sake of their *nerves*. A patient once came to me some five years ago who had to abandon treatment by a neurologist so eminent as to hold numerous college and hospital positions, having also at one time been president of the Academy of Medicine. Operators of this kind lead to complaints that electricity is "painful," while the first rudiments of correct technique would remove the fault and save the fears of the public. It needs no argument to prove the injury done to the credit of electricity as a remedial agent by the frightful mistake of the "death chair" and the numerous trolley car accidents, but the public could be educated to the fact that *medical* currents are *small* and *safe* if it were not for the thousands of persons, in and out of the medical profession, who still *hurt* their patients severely and spread prejudice everywhere. The streets of our city are full of people of all kinds who need "electricity" as in drouth a plant needs water, but

gossips, friends, neighbors and the sensational press warn them of its "deadly" nature, its "shocks" and "burns"; (?) and, sad to say, the upper stratum of medical influence in this country fosters the error rather than gives counsel of the truth.

156. To resume practice: Test further the difference imparted to the same dosage of current by *tilting* the electrode from flat contact till only its *edge* or *point* presses into the arm. By this means you avoid making a change from a large to a small electrode during treatment when you wish to localize action on a small part. The variety you can thus lend a labile or stabile technique is important and calls for study.

157. Practice also with this current how to locate all motor points by slowly moving the labile electrode over any surface till a muscle contracts and thus discloses its center of excitability. No one can remember all the motor points at one time after short study, but a little practice now and then when you are engaging in other tests will soon fix the most important in your mind.

158. Now remove the pad electrode from the stool and note the differences imparted to the same *labile* applications before tested by changing the situation of the *stabile* contact of the current. Place the pad under the arm for one series of tests, then under the upper third of the forearm, then on the extensor surface, then under the arm near the axilla.

Note that the dominant action of a given dosage will be affected:

1. By the situation of the stabile electrode.
2. By the position of the arm.
3. By the relaxation or tension of the muscles acted on.

These factors of action operate on the labile and active electrode in each situation in which it may be placed and can be made to modify the results at which treatment aims.

The study of these tests upon normal arms, arms with thin and thick skins, thin and thick muscles, arms affected by disease or injury, arms the seat of paralysis either peripheral or central, with atrophies, contractions, contractures, or any other pathological states, will in the course of time develop into an expert operator the physician who comprehends the basic principles of electrotherapeutic action and who applies his *mind* when he applies his *current.*

159. Now again sit upon the pad electrode and study the various muscles of the leg and foot. Also repeat tests with the stabile electrode on the inner and outer sides of the thigh, under the heel and under the fore part of the foot. Search out the motor points, familiarize yourself with the relative amounts of current required to produce weak, medium and strong contractions of each main group of muscles. And especially test the variable effects obtained by quick and by slow movements of the labile electrode.

160. In addition to studying the direct actions of any method on the leg it is important to practice in advance of actual patients how best to get at the parts of the leg that are above the knee with the least exposure and the least trouble. Many a physician puts a patient to much needless trouble for want of a little such practice as the above line suggests. No detail is too trivial to deserve attention when it affects the comfort of the patient, the operator, or both.

161. The spine should be studied in four ways:

1. With the *stabile* electrode over the solar plexus.
2. With the same electrode at the base of the spine.
3. With the same electrode on a stool and the patient sitting on it.
4. With the author's bi-polar spinal electrode.

In manipulations over the posterior region of the trunk for selective effects there is room for the display of all the skill in technique that your practice can develop. An

artist will produce a clinical *picture* with his electrode, while the mere mechanic with the same means will only soil his canvas. Or, it may be said, to illustrate in another way the scope for skill, that the artist in technique will produce true therapeutic *harmonics* of current action, while discords and empty sounds will startle the tissues when the tyro strikes the same keys.

162. To be made upon your own back so that you will comprehend the actions and sensations yourself, these spinal tests will of course require an assistant. Begin with test No. 1. Thoroughly wet and soap the 2x3 oval labile electrode and with the current at zero place it upon the lumbar spine. Gradually increase the dosage until it is felt. Then note how much more increase is required to secure a *firm grasp* upon the tissues, but with entire comfort. Note the narrow margin between *full tolerance* and *pain*. Learn to avoid the slight *excess* in dose that will *hurt* your patient needlessly. Make it your rule to never hurt a patient with any form of treatment.

163. Next vary the *rates of interruption* from fast to slow. Vary the *pressure* on the electrode from mere contact to one, two, three, four or five pounds of force. With the most rapid rate of the commutator increase the current to test for tolerance with the active electrode *stabile*. Note the peculiar *ache* that appears after passing the therapeutic dosage and learn to avoid it.

164. Next slip the electrode slowly from the median line of the lumbar region to the side muscles and compare the relations of the same dosage on the central spine and on the adjacent tissues. Compare on the *muscles* all the variations in current-strength previously tested on the *spine* and study the degrees of resulting *contraction*, for these are your measure for standardizing relative doses on parts where no contraction can take place. What I teach in this matter is very important and cannot be studied too carefully by readers who seek to attain scientific accuracy.

165. With the current adjusted to full comfortable tolerance when the electrode is stabile upon the lumbar muscles note the disturbance created by a rapid labile movement from side to side. Still holding the same high dosage move the electrode over the sacrum, gluteal masses and all portions of the lower back, and learn from these tests the practical differences in degrees of tolerance between parts well padded with elastic muscles and parts on which the blows of the current strike on the hard substance of bone but little covered, and which is therefore sensitive to any form of mechanical violence.

Reduce the dosage when it hurts and seek out the variations of current required for equal action on different parts.

166. Next test *sensation* on the central spine and note that if any localized *congestion* or *tenderness* exists the current will be keenly felt on *first contact*, but will appear to gradually die away as sedative vaso-constriction removes the congestion and restores tolerance to normal. The search for *deep-seated localized tenderness*, not discoverable by other methods of physical examination, is one of the first considerations in the first treatment of the spine for any purpose whatever. Electricity will not only detect areas, but remove them.

167. Now test the varying impressions made on the spinal centers by differences in the *rate of change of the labile electrode* when the current-strength has been carefully adjusted for (1) sedative-tonic, (2) stimulating, or (3) nutritional effects. Do not forget the therapeutic principle enunciated elsewhere in this manual that soothing actions require slow and gentle movement to put the parts at rest, while stimulation is accomplished by stirring the parts quickly with energetic rousing manipulations of the electrode; although in both cases the polarity and current-strength may be the same. Between the two extremes there is a wide range for delicate discrimination and judicious skill. Never forget that shades of

therapeutic action depend on much more than current-strength alone.

168. In reaching the cervical spine reduce the current to nearly zero and with slow labile action from the seventh vertebra to the occiput note the increase of dosage required to excite the sense of taste and flash sparks before the eyes. Some imagine that only the galvanic current has the power of exciting nerves of special sense, but I have demonstrated these actions with every type of current that I possess, the only condition being that the *dose* should be adequate and the electrodes properly applied.

169. Repeat on the upper spine the tests you last made on the lower spine and observe here that much less current is required to contract the shoulder muscles, and the tolerance of the upper spine is less than that of the lower. You should compare the *spinal tolerance* with all currents.

In most applications the important nerve centers upon which action is desired are either in the upper or lower spinal cord, while the dorsal region is less sensitive and less important, except when *local* indications there may govern the treatment. Hence study of the reactions of all currents, in all degrees of dosage, upon all the great centers of the cerebro-spinal system is replete with interest and of great profit to the scientific investigation of *electro-physiology* and *correct technique*.

170. After sufficient study of the rapidly interrupted current you should next test the reactions of various muscles with an *interrupting handle*, or by taking one cord tip in the hand and making the circuit in the following ways:

1. With equal makes and breaks at rate of thirty per minute.

2. The same at rate of sixty per minute.

3. The same at rate of one hundred and twenty-five per minute.

4. The same at rate of three hundred per minute.
5. At the highest rate possible by hand.

Repeat similar tests on the same muscles with varying rates of make current, holding the action two, three and four times as long as the interval of break. This is an especially important form of practice, as the *quality* of muscle action thus set up cannot be duplicated by any other means.

171. While noting the altered muscular effects thus regulated at will by the definite application of correct technique to each purpose of the operator you should range the dosage from zero to tolerance and note that current-strength is but *a single factor* in producing therapeutic action, and curative results are not to be expected unless you know how to produce them. It is true that superb results often surprise the non-expert, but he will also often fail when it is easy to succeed, and it is better for you to learn precisely what the indications require and precisely how to meet them.

172. Repeat a similar series of tests with the "direct" current from the same sinusoidal apparatus and note the shades of difference, especially in *muscle action* and in *sensation* imparted by the increased *amperage* now generated.

This current more nearly resembles a small galvanic current in a state of rapid interruption and is therefore irritant on a hyperæmic skin. If the skin is even slightly eruptive it will be difficult to use the current at all. The knack of overcoming the "biting" tendency can only be acquired by practice and by the judicious use of hot water and a bland soap on a well-covered electrode. If the covering of the electrode has been worn thin or is cut through, so that the metallic or carbon base is in the slightest degree exposed, no sensitive *skin* will tolerate more than a fraction of the dose needed for the *deeper tissues.*

172. Those who still have the alternating current of

smaller quantity may make similar tests, but the range of dosage and consequently the extent of action will be found limited by the restrictions inherent in the lack of *volume* and *flexibility*. But the *soft current* from this apparatus does not "bite" even a very sensitive skin, and though it has been abandoned by its former makers there are a number of its kind in use, and those who own them will be glad to retain them in their armamentarium and to learn how to improve their skill. For this reason it is worth while to include the apparatus in this book as it will be employed for many years to come, and there is little literature on the subject to assist those who purchased it before the Edison Manufacturing Company stopped making it. It should be developed rather than abandoned.

173. Many questions have been put to me by physicians in regard to the treatment of *constipation*, the action of each current upon the abdominal muscles and the possible influence of surface applications upon the involuntary muscle fibres of the intestines. These questions can for the most part be answered by making the series of tests which I have demonstrated to students in rapid order in a single seance on a single patient. If you will make yourself serve as the patient you will possess more accurate information on the subject at the close of the sitting than the ablest theorist could obtain out of the studies of a library in a year. Owing to the large sums spent by the laity on laxatives of various kinds it would appear as if there was a large field of usefulness for electricity in "curing" constipation if it was able to do it.

Since I have enjoyed the addition of the larger sinusoidal current to my therapeutic resources my results have been better and in some cases remarkable.

174. Remove coat and vest, roll up your shirt and recline with extended legs on an operating table, with a pad electrode under the lumbar spine and your head propped up by pillows so that you can see your abdomen

while you are testing it. Take one of my carbon sponge-covered labile electrodes and prepare it with the usual hot water, soda and soap. Connect the cords first with the galvanic current. With the labile electrode applied in turn to each important motor point increase the slowly interrupted galvanic current, negative pole, from zero till the muscles stir. As you gradually increase the current note the relation between *dosage* and the *contractions* until the limit of tolerance is reached. The *lift* of muscle fibres is quite broad, owing to the amperage of the current, but the blow of each contact simply jerks and *lets go.* Change to the *constant* galvanic current and next test interruptions with the tip held in the hand. Note the bite upon the skin of a large dosage and study all the details of effect.

175. Then at once shift the coils to the coil apparatus. Test the slow interrupter and note at once how illy it is adapted to deep abdominal work. Then change to the rapid vibrator and the 2,500-yard combination of coils and observe that the attenuation of the amperage *diffuses* the action instead of *localizing* it as needed. Even the full energy of four cells is insufficient to make this long faradic coil set up effective local peristalsis on a stout adult. Change to the 1,000-yard No. 36 coil and you at once find that the dosage can be adjusted so as to produce vigorous local contractions. The 500-yard No. 36 coil next increases the local effect. Then see how the greater amperage of the coarse wire coil—500 yards of No. 32 wire—takes closer, deeper and stronger hold upon the muscles near the electrode because its local action is greater than its diffusion. It enables you to regulate the dose better. The muscle action can be still more intensified by next switching in the 300-yard 32 coil and adjusting the dosage to the maximum of tolerance.

The shorter and thicker the coil, with rapid and smooth interruptions, the greater is the conducting capacity of the wire and the localization of the current. Test every possible dosage—stabile, slow labile over the colon tract,

more rapid labile, intermittent on motor points—with all three variations of current, continuous, swelling and slow make and break.

176. Study the excursion of the umbilicus and of the oblique and rectus muscle fibres as the tetanizing current is raised from zero evenly and *slowly* up to tolerance. It does not necessarily hurt, but can be overdone by a tyro. The master-hand will do just enough, and stop without a word of caution from the patient. Test a very rapid rush of current from zero to maximum, and equally rapid *decrease*, and compare the sensations with the slower and usual method. You will not only thus learn which is the best, but also why it is best.

177. Next shift the cords to the finer sinusoidal current of small amperage. At the full power of the current the muscles bunch and swell, but it seems an action of the *surface layers only* and does not impress the observer or the patient as if it grasped the intestinal fibres in an equal vise. It is obvious to the trained eye that the current is too small for the work required. A few tests satisfy us on this point and we now change the cords to the alternating current of the newer sinusoidal apparatus, which is my chief resource for abdominal stimulation of this kind at the present writing.

178. Repeat the tests. See how comfortable it is. How wonderfully it grasps the muscles. Note the greater excursion of the umbilicus within the range of a tolerable dosage. Note the deep oblique depressions in the course of each colon that begin in a mere *dimple* at the first stir of the current and gradually become a *guleh* as the dosage proceeds towards tolerance. Note the great and facile flexibility of the dosage; the sedative tonic action of it; the tremendous impulse to peristalsis; the deep and penetrating action; the immense mechanical disturbance without sensory distress, and you will recognize the superiority of this current for this particular work over any other resource in the field of extra drug therapeutics.

Abdominal massage and exercises would appear to be very greatly inferior to it. In practice this technique is a joy to the patient when skillfully done on a sound skin, and the results are extremely gratifying.

179. Lastly, change the cords to the Leyden jar current of the static machine, using the smallest jars, and repeat as near as possible the same tests. Note the different action *immediately beneath the labile electrode.* How it *bunches* the surface muscles instead of *diffusing a wave of contraction.* Its power is great, but its convenience is not equal to the demands of practice. It requires considerable skill in dose regulation, for it easily oversteps the sense of comfort and near or on any thinly covered bones its peculiar ache will not easily be forgotten. I demontrate it, but never use it for peristalsis.

180. For constipation there are two other resources of static electricity: *mild sparks and frictions* over the liver and abdomen, and my "interrupted static current," originally described by me in the Medical Times and Register, September 9, 1893. Test them for your information and compare the therapeutic possibilities with the methods and currents tried before. No two have proved to be exactly alike.

181. Five forms of apparatus, eleven separate currents, employed with three types of interruption, and with endless variations in dosage and technique, are thus tested in an hour. *No physician who has graduated from such a test will again ask the questions of the tyro.* He will know for himself all there is known on the subject.

The efficient, deep-acting, tetanizing *grasp* which presses down through the surface muscles and seizes the intestinal fibres with a firm clutch which is judiciously intermitted by the *technique* of the operator is obtained best with the large sinusoidal current, and next with the largest coil currents of the author's improved and scientific faradic apparatus. To be appreciated this action must be both *felt* and *seen.* With other currents and with

inferior skill the physician may attempt to do the same thing, but he will fall short in the attempt. I have referred in another chapter to the importance of also familiarizing yourself with the difference in the efficiency of the same current and dosage on different persons of different degrees of obesity or the reverse and need not include the directions here. The reader should study this small manual in its entirety and combine the details of the several chapters.

182. In stimulating the intestinal tract in cases of deficient peristalsis, or deficient secretion, there are seven principal situations in which to make deep pressure on the external surface. These are the motor points of the oblique abdominal muscles on each side, which can be made to contract the ascending and descending colons; the motor point of the rectus abdominis, the right and left inguinal regions; the site of the gall bladder, and the region of the solar plexus.

183. With an *inadequate current* the clinical results with even very good technique may disappoint both patient and physician, and not the least important part of educated skill is the knowledge of what *constitutes the efficiency of a given current for indicated work of a given kind.*

Herein lies the secret of so many lamentable failures in electro-therapeutics. Last winter a physician called upon me to see about instruction in static technique. He introduced himself as a specialist in nervous diseases in a large city of New England, "making much use of electricity and desiring to extend his knowledge." Within ten minutes he was assuring me that "with a ten-dollar faradic battery he could get about all the effects needed, and that it was a mere fad to claim that other batteries would give any better effects, and he only wanted a static machine to impress his patients with."

I pity the *patients* of such a man, but will not argue with him. He can remain purblind if it is a personal

satisfaction, but his ignorance does not make the *standard* of modern, scientific electro-therapeutics.

184. The next important region for experimental work is the male perineum, than which there is none of greater interest in a large class of genito-urinary cases. Place the selected patient in the same position as for vaginal bi-polar administrations in the female. Put the pad electrode under the extreme base of the spine in one series of tests, and under the lumbar region in another series. For the purpose of experience it is well also to apply the stabile electrode on the abdomen and over the bladder. In actual practice, however, there should be a definite indication for these positions or the *muscular* effects with a full dosage may be uncomfortable.

Another reason why I usually select the spine for the pad electrode is that the nervous path of conduction between the important organs and the great nerve centers is then directly traversed by the current between the electrodes.

185. Have the patient hold up the testicles so as to put the skin of the perineum on the stretch. Use the 2x3 carbon disc sponge-covered labile electrode. If there are any abrasions, scratch marks, or breaks in the skin the current will bite so much that a useful dosage cannot be developed on account of the sensory disturbance, although on a sound cuticle the same application is a luxury and delight. It may bite somewhat at first on any skin that is highly vascular, but in atonic and anæmic states there is usually great tolerance and perfect comfort.

Have all else ready before applying the electrode to the perineum and have this not only well wet and soaped, but as hot as the hand can endure to press it out. Remember the precaution, always use a very hot electrode on the perineum.

With the large alternating current from the switch button "A" increase the dosage from zero to a moderate

grasp upon the muscles, with the electrode pressed steadily upon the center of the perineum. In this situation test the range you can *swell* the current by a *rapid* increase and then note how you can *slowly coax* the dosage by patient manipulation far beyond the possibilities of the rapid method.

186. Retaining a comfortable grasp upon the muscles slowly tilt the electrode to one side and then the other, noting the change in the muscle grasp; and then slowly traverse the median line of the perineum between the anus and the border of the scrotum. Practice *labile* dosage here.

After testing graduations of pressure, current-strength and rate of change of the electrode alter the method to slow interruptions, and next to the swelling method. Perfect control of the rheostat and knowledge of tolerance is required to direct this "swelling" method to the sole end of benefit, for the repeated strain of an excess of contraction (overdose) will exhaust the muscle fibres and leave behind more "weakness" than the patient brought to the office.

187. In a good light watch the deep action upon the muscles concerned in the integrity of the pelvic floor and the function of erection. With a powerful dosage the contractions can be spread to the abdomen and down the legs to the feet as the electrode treads upon the different motor points with the great force of a skillfully handled steam hammer.

188. So far-reaching are the maximum contractions that can be comfortably induced with this giant current, and also with the slowly interrupted galvanic current with the electrode on the perineum, that I have had cases report a radical cure of chronic constipation during a course of treatment for simple impotence. As to the welcome accorded this treatment by tissues that *need* it no better idea can be conveyed than appears in the look of ecstacy that is often visible on the patient's face. Some-

thing, too, can be judged by such remarks as the following, and many similar:

"I cannot begin to tell you in words how good that feels."

"Oh! that is magnificent."

"That is worth $4.00 a minute."

"I would rather go through this treatment than any amusement I know of."

But no expressions of delight will greet the operator if the skin is broken, the current inadequate, the electrode improper and the technique betrays not the trained artist but the "day laborer." Prestige, reputation in other fields of medicine or surgery, will not alone suffice for skill in electro-therapeutics. Each detail must be mastered in the school of *experience*, and the equipment of apparatus must be linked with an equipment of knowledge.

189. There are many cases of sexual debility with symptoms referable to atony or irritability of these muscles and the tissues related to them. Irritation, congestion or atony are the three important factors in functional cases. An editorial in one of our leading medical journals some two or three months ago remarked on the subject of "Sexual Health":

"A want of circulation in the parts is responsible for most cases of sexual frigidity in both sexes. Eighty per cent. of impotents suffer from prostatic congestion, hyperæsthesia of the deep urethra, and weakening of the muscles which govern ejaculation, resulting in premature erections and premature emissions, a premature want of power."

The proper use of electricity combats these conditions better than any known drug remedy. When the patient will join in the effort to cure him I am confident of good results, but in some cases the mental state renders the patient intractable and he is fickle in attendance and finally fails. Physicians have consulted me on these cases

who have failed in all their attempts at electrical treatment, but it appears to be the result of their using inadequate currents and methods. Granted a patient with a fair prognosis I feel certain of success if he gives me a fair chance to treat him.

190. The next procedure tests this sinusoidal current with the technique of *vaginal bi-polar* faradization. Connect the electrode as usual and let the patient support it with the author's "handle," which releases your personal attention from the electrode. Test the sensory effects as the rapidly interrupted current rises from zero till it grasps the tissues strongly.

Contrast it with the various coils and with the lighter sinusoidal current, if you have it. Vary the dosage, the rate of interruption and the rate of increase and decrease of current-strength. Test the "swelling" method and note the degree of muscular contraction that can be obtained within the patient's comfort.

The *amount of retraction of the anus* is the silent guide to tolerance and the limit of dosage, and once mastered there are few questions you need to ask the patient about current-strength.

When muscles can be seen or felt by the operator as they contract to current action the author's rule of *elasticity* is the basis to scientific precision in dosage. It does much to make electro-therapeutics an exact science, and when aided by the *ear* and *sense of touch* as taught in my clinics, there remains little guesswork in skilled administrations and the adaptation of technique to therapeutic effects.

191. It may be said by the student at the desk that these complex experiments are tedious and unnecessary. On the contrary, they are in practice full of unceasing interest. What I have detailed in this manual are but a fraction of the tests I have annually made with my students and never with a dull moment. Experience teaches me that they are the indispensable and only foundation

of skill, and I have spent hundreds of hours year after year with engrossing interest in this kind of clinical work. Students who express surprise at the ease with which I have often compelled currents to yield desired results in difficult cases may reflect that the facility of the juggler in any branch of skill has underlying it an indispensable amount of daily training. The marksman, the golfer, the billiardist, the telegrapher, the painter, the athlete in every sport, the artist in every art, the rapid piece-worker in every factory, are alike dependent for their ability *to produce success* on the elementary routine of *practice*, and the master of electro-therapeutic technique must follow their example.

192. The physician should also test and familiarize himself with the actions of this current on the rectal tissues, on the testicles, penis and prostate gland. The utility of such methods as I employ in various conditions of these parts seems to be unsuspected by most physicians. So many are attempting blind lottery-work around the genito-urinary organs with inefficient currents, without rule of dosage, and with no definite technique, that the whole subject is like a virgin park which is open to the public, but which few enter. I have gone to considerable trouble to test every possible variation of current action with reference to functional sexual and rectal derangement of circulation, enervation and muscular tonicity, and in proportion as experience has developed my skill there has been a corresponding development in my clinical results. But it has been only since my acquaintance with the larger sinusoidal current that my studies have borne their best fruit. So far as I am aware at the date of this writing there is but one apparatus of this type in the market, but it fills an important gap and should be still further developed.

This is the first book on the subject of electro-therapeutics which has given the sinusoidal equal representation with the other and better known currents, and if you

study the *physiological actions* in my other book, as I have suggested in Section 132, you will be able to get the *technique* here and make admirable use of this form of electricity.

193. One closing word in regard to the *therapeutic uses* of sinusoidal currents. It has not been the purpose of this book to reach beyond *technique* into the fields of *physiology* and *therapeutics*, nor is it necessary when the true and basic principles of prescribing "electricity" are comprehended by the student. You do not ask for a list of every disease in which you should prescribe digitalis, for instance. You learn its action and dosage and when you meet a case requiring digitalis, no matter what the name of the disease, you recognize the "indications" from your knowledge of the drug *action*. That is all there is to the choice and prescribing of electric currents. Each current is a separate remedy to be prescribed only according to the *indications for the actions that can be set up by it through the agency of correct technique*. The physician who asks when he should use a sinusoidal or a faradic current is in the same stage of mental acquisition as the undergraduate medical student who asks his preceptor "when he shall use" any of the leading drugs in the materia medica.

The keynote to prescribing is knowledge of drug and electrical action. After the study of text-books the practical tests of current actions can be made as directed in this manual, and when the student is once grounded in the major facts he can take up any unfamiliar current, as for instance, the sinusoidal, and determine its *qualities* and *range of action* in a very few hours, so that he can at once prescribe it with confidence without any list of diseases or reports of what others have done with it.

I speak of this because I have been asked the above question so many times. Physicians look for reports of clinical cases for confirmation of the value of the sinusoidal and other currents. No such reports are sought

by the expert. He cares little what others have done; he proceeds to make his own personal tests and when they reveal to him the *quality* of current, *range of dosage* and *character of actions*, his general medical knowledge of *therapeutic principles* is all that is needed to place the whole repertory of prescribing at his command.

It has been suggested that I write to a number of physicians whose experience with sinusoidal apparatus has been large and obtain a series of clinical reports for this book, as no book yet in print deals extensively with the current. But it would be useless. *The whole picture of clinical possibilities is open to the instant glance of the master of action and technique*, and to aid the beginner study should start at the other end. Ignorance alone is puzzled and gropes in the dark. Get the proper rudiments first and confusion about when to prescribe a given current and how to dose it will cease.

CHAPTER IV.

GALVANO-FARADIC AND GALVANO-SINUSOIDAL CURRENTS.

AN ORIGINAL STUDY.

Principles of Combining Currents from Two Separate Batteries.—Relations of Voltage and Amperage.—Clinical Tests.—Chief Uses of Combined Currents.—Dose Regulation.—Qualities.—Proof of Action.

Readers of electro-therapeutic literature are accustomed to meet occasional references to a combined "*galvano-faradization*" of muscles, etc., which is said to be "more *tonic* in its action than either current alone." Little practical use is made of these scattered and casual references, because they never furnish the untrained physician with working details of technique. For the first time, therefore, in electro-therapeutic writings, I shall now devote enough space to these combinations of galvanic with induction coil and also with sinusoidal currents to make clear their qualities and how to use them.

Static electricity cannot be combined with any other form of electricity in the treatment of patients, because it requires *insulation* and a condensing process. No combination is needed, because auxiliary effects can best be produced by separate means.

The *galvanic* current can be combined with any other currents which are employed *under similar conditions of circuit and conduction.* In practical use these are induction coil currents and currents from one type of sinusoidal (induction) apparatus.

No extra switchboard is needed, though "combination"

cabinets usually have a special switch to join the coil and direct currents together. Older writings refer to a separate device for this purpose, but I have no occasion to use one, and would regard it as a hindrance rather than a help.

Modern high-grade cabinet batteries often supply the galvanic and faradic currents within the same case, but the only essential requisite to combining two separate batteries is that they shall conveniently stand within a few feet of each other. Then one extra conducting cord or wire is all else that is required. I have long had a "combination" cabinet in my office, but never use the two currents by means of the "combined" switch. It cannot be done with proper dose regulation for fine work. Its fifty galvanic cells are wired in groups of ten. The one rheostat of the cabinet will act as a *resistance* current-controller for the galvanic circuit, but only as a *shunt* controller for the coil circuit. A switch will change its connection from one circuit to the other, but no switch can make it work in two opposite ways at one and the same time. Therefore, if I use this rheostat with either of the "combined" currents, the other is imperfectly regulated. The annoyance of this in practice need not be set forth here. A few minutes' actual test of the apparatus would make clear to any student why it is more practical to have separate galvanic and faradic batteries.

194. The essentials, then, for using the combined currents are:

a. Each battery must have its own separate rheostat for the dose regulation of its own current independent of the other.

b. The rheostat of the faradic battery must be only in the primary circuit, as the galvanic current will be nearly stopped by high secondary circuit resistances.

195. Now place the separate portable faradic battery beside your galvanic cabinet. Take three conducting cords, and any two small sponge-covered electrodes that

can be conveniently held in one hand for your first tests. Wet them as for galvanic work and proceed with the following steps:

a. Connect one electrode with the galvanic positive pole.

b. Connect the other electrode with the faradic negative pole.

c. Attach the third cord to the two terminal posts left open.

d. Switch in any desired number of galvanic cells, 10, 20, 30, or 40, and place the rheostat at zero.

e. Select any coil, say the 1,000 yard, No. 36, and start the faradic current so as to adjust the rapid vibrator to proper action. Leave the current at zero, either by withdrawing the coil from the primary, or by controlling it with the rheostat.

f. Grasp both electrodes in the left hand so as to leave the right free to move switches. Keep the electrodes about an inch apart.

g. Increase the galvanic current to about 3 miliamperes.

h. Increase the faradic current to about half tolerance, and leave it at that point for the present.

i. Now slowly and cautiously raise the constant galvanic dosage from 3 to 5, 6, 8, 10, 12, or 15 mil., noting actions as the dose advances.

j. When the coil current gets too strong reduce it and again increase the galvanic.

k. Reduce the galvanic from the maximum and note how the reduction affects the intensity of the coil current.

l. Raise and lower each current separately, and note how each reacts upon the other. It is a fine study in the relation of amperage to voltage. The phenomena of different sizes of wire, either long or short, can be demonstrated with a single long coil by the fluctuations of amperage through the galvanic addition to the circuit.

m. Break the circuit of either current and note that

both stop acting on the tissues, although the faradic vibrator is not stopped by merely cutting out the galvanic.

n. Observe the effect of "swelling" each current, and contrast the faradic swellings with the galvanic swellings. In practice there is often a choice, one being more agreeable or more efficient than the other.

o. Interrupt each current at various rates and test the usual changes in action.

196. Now, what have we learned thus far?

These initial tests teach that by passing both currents around the same circuit and through the same electrodes the galvanic adds its *amperage* to the coil, and the coil lends its *voltage* to the galvanic. The net result is a current with *mechanical* action, supplemented by *chemical* action, both factors in the combination being under exact control and adjustable to any desired degree.

It is truly said that it is more *tonic* to muscle fibers than the galvanic current alone, but in practical use the satisfaction of the operator will depend on his skill in adjusting the relative dosage. It can be made to act essentially as if a given coil had the calibre of its wire increased and variable at will. The galvanic volume swells the amperage of the 1,000-yard 36-coil, so as to practically transform it into a 1,000-yard No. 32, or 30, or 24, or 21, or coarser wire, according as the galvanic part of the current is advanced from zero to the maximum dosage. This is the result upon the coil element of the combination.

On the galvanic side we see that the rapidly interrupted coil current imparts a tetanizing action on muscle fibres that the medical constant current does not possess alone, and that it adds a mechanical force to a few mil. such as we could not obtain from a pure galvanic dosage within tolerance. If we run up the galvanic current alone to 150 or 200 mil., we will get pronounced voltage also, but patients are not treated with such doses under ordinary circumstances. In making these tests note that

the polarity follows the galvanic switchboard and ignores the faradic. Your positive pole to the patient is the positive pole of the galvanic current and the negaative likewise.

197. Having now thoroughly grasped the significance of combining the two currents, it only remains to become skilled in the *technique* of administration.

The dominant uses of galvano-faradization are in the field of the faradic currents rather than galvanic. Atony of tissues, whether muscular, vascular, or nervous, is efficiently combatted by it. Exclude electrolytic uses, applications to mucous membranes and the special work of amperage with low voltage. This leaves clear the indications for galvano-faradic therapeutics.

While it is some slight trouble to combine and regulate this current, yet facility comes quickly with practice, and I am as little taxed by the details as by the technique of single currents. There is, moreover, one quite important advantage of this combination. By operating the slow interrupter of the galvanic battery at rates of from 75 to 150 periods per minute while the rapid vibrator of the faradic battery is in action, we conveniently secure the peculiar and especially nutritional muscular contraction that I have referred to at length in other writings. I therefore, often employ the combined current for this purpose alone.

198. Knowing now the quality and character of *galvano-faradic* currents and recognizing that these vary in proportion to the ratio of voltage to amperage—a matter of dose regulation—we can proceed to practice any or all of the tests described in the chapter on coil currents, and also any described for sinusoidal currents, as there is no difference in the manipulation of the *electrodes*. *Quality* of current indicates the uses of each and all currents, and to determine quality you must make tests.

Particularly test the shadings of pressure, rates of interruption, and all labile technique, and note that the in-

dications for the galvanic part of the dosage fall mostly between 5 and 15 miliamperes. Use bicarbonate of soda and soap on the electrodes, and observe all the precautions required in galvanic work.

Do not use the bare metal bi-polar electrode in making your tests, as the nickle plating will disappear if electrolytic amperage attacks it.

199. Can sinusoidal currents be combined with galvanic in the same way? They can. Simply connect the third conducting cord to one terminal of the galvanic and one terminal of the sinusoidal, and regulate the dosage of each current separately the same as before.

In all tests with combined currents note how the larger amperage aggravates the *sensory* effects. A fine current can be made to become harsher and more biting in proportion to excess of galvanic, but skilled dose regulation will, of course, avoid intensities that produce discomfort.

In the case of the fine sinusoidal current from the "Edison Alternator," it may be considered that, when indicated, the greater amperage of the galvanic circuit will add to it a wider scope of action. I have perfectly demonstrated the feasibility of combining the two currents, though I am not aware that it has hitherto been done by others. When, however, we wish to add a small amount of amperage to the McIntosh sinusoidal current, we can move a switch-arm from the "alternating" to the "direct" button, and obtain a modification of both voltage and amperage. The modification of the alternating current of this apparatus which results from the addition of galvanic amperage is of a much wider range, however, and possesses a more flexible dosage.

The ability to combine galvanic with either faradic or sinusoidal currents is an additional resource to every other form of apparatus, and experimental research along the lines here laid down will greatly enrich the knowledge of the physician. As the preceding chapter dealt with the subject of sinusoidal technique, the two

chapters should be studied together. Whenever two electrodes may be applied in precisely the same way with two different currents, the study of the operator is then to be directed to the variations in therapeutic action and the study of physiological effects, and on these points he can never learn too much.

Adapt every suggestion you obtain from the chapters on galvanic, faradic and sinusoidal technique to tests with the *combined* currents, and you will not need to have the directions repeated here.

200. But, you ask, how do we know that in these "combined" currents we obtain the full unaltered galvanic action? The faradic or sinusoidal part of the combination speaks for itself to any tissues that come in contact with an electrode, but the constant galvanic current does not reveal itself in the same unmistakable way, and we may doubt whether or not we actually get much of the *constant* electrolytic action when a rapidly *interrupted* action is going on in the same circuit. Proof, however, is simple.

Take a hard-boiled egg, with the shell off, and plunge into it the two pieces of copper wire which you attached to the tips of two conducting cords for your tests of cupric electrolysis. On the faradic side of the current take the "direct" action of two cells—the rapid vibrator, and the 1,500-yard No. 36 coil. On the galvanic side use 20 miliamperes of the constant current without any interruption. In three minutes observe that at the negative pole the electrolytic action has already softened the egg round the wire that it is falling out of its own weight. Observe that at the positive pole the familiar green oxychloride of copper has already freely formed, and the wire is fast adherent to the substance of the egg. Make a three-minute test in the same way with the galvanosinusoidal current, using the Edison apparatus, and note that you obtain the same response from 20 mil. galvanic. Repeat it with the McIntosh apparatus, and note again

that the evidence of electrolytic action is the same. This action is the same in all three cases, except in the one minor detail that the high-tension coil used for this test has a higher internal resistance than the sinusoidal windings and holds back the galvanic current so that it requires more cells to raise it to 20 mil.

The demonstration of the full action of each current when they are combined together is as complete as it is possible to demonstrate their action separately.

201. But before any reader attempts these experiments with any sinusoidal apparatus, it will be necessary to first note the character of the *primary* excitation. Two methods have been employed by makers of sinusoidal machines, and one of them will not take the galvanic current without injury.

In my original tests I noted that the current from one type of generator gradually failed until in about two weeks it was almost at zero at the terminals. It was the horse-shoe magnet type, and the battery acted as if the magnets were steadily losing force. The other type of generator excited by the reduced street current did not appear to suffer injury. After my own observations were complete I addressed inquiries to both makers, and will quote their replies. My own letter asked them to *make official tests, so that an authoritative statement* could be made. The McIntosh Battery and Optical Company reported:

"Regarding the use of a direct current in conjunction with the sinusoidal as given from the generator, will say that we have made some experiments along that line after receiving your letter of recent date, and have discovered that it had a tendency to weaken the magnets by backing up the lines of force. The backing up of the lines of force through the permanent magnets had a tendency to demagnetize them, and we have no doubt that this is what occurred to your generator when the strength fell. To avoid this we can supply you with a

generator having an electro-magnet field, being excited by the same current which is used to operate your motor. In this case there would be no trouble in using your direct in conjunction with the your sinusoidal current, or, in other words, superimposing the sinusoidal wave on to the direct current E. M. F. This would be perfectly safe and could do no harm to the generator."

As this machine can, therefore, be made in either of two ways, it only remains for buyers to state their choice. Recent tests have also led me to suggest other alterations in this admirable instrument which will widen its range of dosage and essentially improve its action.

The Edison Manufacturing Company wrote me as follows:

"In reply to your favor we beg to state that we do not think it would injure the Sinusoidal Alternator to combine the sinusoidal current produced by same with the galvanic current. The effect would be similar to the combination galvanic and faradic current, except that the pulsations of the sinusoidal-galvano current would be greater than with the galvanic and faradic."

If this statement is correct, the reader will not harm his apparatus by careful tests, but it will be well for beginners who do not yet know the rudiments of electrical actions sufficiently to detect impending injury before it happens, to wait till later experience ripens their judgment and better fits them to explore safely a not too easy field.

CHAPTER V.

STATIC ELECTRICITY.—STUDIES IN THE AUTHOR'S TECHNIQUE.

Summary of Static Methods Taught by the Author.—Systematic Personal Tests for Skill.—How to Train the Ear, Eye and Hand of the Operator.—Principles Made Clear.—Author's Original Instruction in Scientific Dose Regulation.—The Art of Artistic Technique.—How to Become Expert.—Treatment of Consumption.—Author's Electrodes with Uses of Each.—A Series of Home-Clinics Designed to Make a Skilled Operator Out of the Novice.—Supplementary to All Other Writings of the Author on This Subject.

The development of static electricity from a discredited and doubtful remedy to a therapeutic agent of the first rank has been commensurate with nine things, to wit:

1. The manufacture of machines giving sufficient current.
2. The understanding of the physics and physiology of the current.
3. Improvement in electrodes and accessories.
4. A system of scientific dose regulation.
5. Knowledge of all therapeutic effects and how to produce them.
6. The uplifting of technique into a fine art.
7. The publication of an authoritative text-book on this subject (1897).
8. The convincing demonstrations of the author's clinics.
9. The author's adaptation of Crookes tubes to high-grade X-ray work with the static apparatus when it

had been discredited by all other leading investigators. The modern vogue of the static machine may be said to date from my article on "Crookes Tubes and Static Machines," published in the Medical Record, February 6, 1897, and representing my X-ray work for the second half of 1896.

My own part in this development may be stated as follows:

My elucidation of the properties, character and actions of static electricity has cleared the subject of confusion for all students of my teachings.

The electrodes and accessories devised or improved by me have enlarged the usefulness of this agent.

I have originated or improved important methods of application, and have taught how to make existing methods more efficient.

The system of scientific dose regulation, which makes this apparatus an instrument of precision, originated with me, and has been taught only in my own clinic.

The knowledge of possible therapeutic effects has been extended by my clinical investigations.

The knowledge of how to produce and reproduce at will any desired effect to meet indications has been the result of my instruction in dose regulation and improved methods.

The evolution of *technique* from a crude routine into a fine art of great flexibility and discrimination has been in chief part a gift from me to the medical profession.

The first authoritative and complete text-book on this subject ever written in any language was my "Manual of Static Electricity in X-Ray and Therapeutic Uses" (1897)—a book written by me in the face of determined opposition and prejudice. It has revolutionized the preconceived opinions of its readers, and has greatly multiplied the number of static machines in this country. On this point a prominent medical journal in Cleveland, Ohio, commented in 1898 as follows:

"Within the past few years there has been a remarkable increase in the use of the static machine, and one of the foremost in advocating and popularizing its use in the profession has been Dr. S. H. Monell. He has also forced the recognition of the static machine as a means for producing the X-ray, and that against determined opposition. A visit to his office gives no indication of ostentation or exaggeration, but convinces one that he is moderate in his claims, and has accomplished what he has by hard work and unremitting attention."

As to the convincing nature of my personal demonstrations covering skill in technique, novelty and variety in method, accuracy in dose regulation and quickness and precision in procuring definite effects, it can be stated to those who have *not* witnessed them that physicians who *have* witnessed them and have taken part in the instruction of my clinic, make many such statements as the following:

"In your hands, static electricity is an altogether different thing."

"There is more to static electricity as you demonstrate it than I ever supposed possible."

"I have taken instruction in other clinics, but till I came to you I thought there was very little in this current. I now see there is very much."

"To come to your clinic from the school where I took a three-months' course last winter, is like coming from a day laborer to an artist."

"I spent four and a half years under Charcot, in Paris, and was familiar with his use of static electricity; have also studied it in this country, and have had three machines. I thought I knew all there was to the subject, but I now see that I knew nothing about it."

"I have attended other New York electro-therapeutic clinics for three months, and was just going home to fit up my office with apparatus, feeling that I knew it all; but after watching you teach static electricity for twenty

minutes I realize that I know nothing about it, and want to stay and take a course with you."

"I have seen every leading clinician in Berlin, Vienna, Paris and New York during my past two years of post-graduate study, but I never saw any one handle a static machine as you handle it."

"No one who does not *see you actually do it* can understand or believe it."

"I spent two and a half years in Paris observing Charcot and others, and have taken instruction of all the leading teachers in Philadelphia and New York, but must say that other methods with static appear to me to be child's play compared with what I have seen you do."

"Before I came to your school I thought your book was exaggerated, but it does not tell half."

"I can testify to the fact that you demonstrate a great deal more than your books claim."

"Those who use static electricity without instruction, or as it is commonly taught, have no idea how much they lose."

"It is clear to me that no one can duplicate all your effects unless he has had your instruction, for the way *you* manipulate electrodes cannot be got out of books."

"I can now see that all your special details are essential and whoever does not think so, simply shows his ignorance of the subject."

"If I had learned from you nothing but how to regulate the dose of static sprays, it would have been worth all it cost me for my entire course."

"Your electrodes always seem to do exactly what you want them to do."

"The static machine is so wonderful in your hands that it is strange that so few physicians know how to use it."

"If every physician in this country was able to do what you can do with the static machine, it would result in a greater benefit to patients than any new medical discovery that now seems possible."

Scores of other expressions by different physicians could be cited—the voluntary recognition of previously skeptical men, convinced by absolute and repeated demonstrations. These remarks are not quoted or accepted as personal compliments, but as simple tributes to the merits of static electricity. I omit many of a more personal nature, and cite the above only in the hope that they will lead readers to investigate for themselves.

The majority of untaught operators err in one of two ways. They either make the dosage *inadequate*, so that it does little therapeutic work, or they make it annoy the patient through either an excess of severity or methods not suited to the indications. Great harm to the repute of medical electricity, therefore, results in many cases, while proper knowledge of technique would lead only to satisfaction.

202. What I here teach in words I have been teaching in object lessons to those who have attended my clinics, but as the number who can seek their instruction in that way is limited this book will help many who are in great need of it.

There has, of course, been constant growth in my experience and my teaching, for I have not stood still since the publication of my previous books. My students of 1896 were not taught some of the things that I taught in 1900, but the following summary embodies the substance of my latest clinical instruction:

Proper emplacement, adjustment, grounding and management of the apparatus. Necessary care of the machine; drying of the chloride; use of motor and rheostat; source of current; relation of poles; speed of plates; leakage; waste by poor conduction; proper connection of platform. Various tests of current strength; how to modify dosage; charging and discharging machine; how to correct reverses of polarity; how to prevent tendency to frequent discharge and reverse; how to make machine work well in summer, and in all atmospheric conditions; how

to obviate petty annoyances and be satisfied every day in the year.

Demonstrations of many common errors about static electricity.

The art of management of patients during treatment.

Proper duration and frequency of treatment.

The control of unfavorable conditions, the production of definite therapeutic effects to meet definite indications and the application of the principles of medical therapeutics to static electricity.

The practical uses of the author's set of essential electrodes and insulated electrode handler.

Important uses of the sliding poles.

Object lessons in technique, embracing:

Varieties of sparks—local, general, single, multiple, long, short, needle, frictional, slow, rapid, thin, thick, low voltage, high voltage, from ball or point electrodes, and with four methods of connection.

Dosage of sparks as follows:

Dull or sharp, for superficial or deep muscle contractions.

Sedative, irritant, tonic, or stimulating sparks.

Nutritional and alterative sparks.

Obtunding and pain-relieving sparks.

Mixed sparks and sprays.

Heat-producing sparks.

Sparks to forehead, sides of nose, eyelids, cheek, neck, nape, ear, larynx, chest, region of heart, liver, spleen, solar plexus, bladder, abdomen, lumbar region, spinal centers, sacrum, arms, forearms, hands, palm, dorsum, thighs, lower legs, anterior and posterior, ankles, feet, soles and all large and small joints.

Breeze applications as follows:

Positive, negative, constant, interrupted, stabile, labile, concentrated, diffused, with exact dose regulation for all parts of the body.

Spray applications as follows:

An elaborate series of demonstrations, largely original with the author, showing how to make the spray in turn, with exact precision, restful, soothing, sedative, cooling, warming, hot, neutral, bland, tonic, alterative, stimulating, soft, pricking, sharp, irritating, counter-irritant, sand-blast, rubefacient; the "balm of Gilead" to pain, congestion, inflammation, soreness, and nervous tension; the most flexible, useful and important variety of technique after sparks. Scientific precision in dosage in accomplished by the author's methods, and without them precision is impossible.

Leyden jar currents as follows:

General and special uses, dose regulation, varieties of electrodes, water bath methods of the author.

Massage roller applications as follows:

Different methods of use and dose regulation for different degrees of action, with slow or rapid interruptions of current.

General electrification as follows:

Positive or negative; dose regulation; tests for efficiency of current action.

Frictional applications as follows:

Exact dose regulation for each desired effect; manipulations of the electrode, how to produce different degrees of action; how to avoid all annoyance to patients; how to know whether the right effect is being obtained, and when it is complete; how to tell exactly when to stop.

"A New Static Interrupted Current; a new System of therapeutic administration of Static Electricity, based upon the principle of Potential Alternation."

This system of *interrupting* and employing the *direct* static current, without Leyden jars, was first described by the author in the *Medical Times and Register*, September 9, 1893. I teach *general* and *local* technique, covering: Potential alternation; how to adjust for maximum therapeutic action; protection of patient; length of spark

gap; speed of plates; how to start and stop; sedative-tonic effects; local P. A. current; an ultra-high potential sinusoidal treatment; rapid and slow interruptions; swelling method; local uses of author's "sparker" to larynx; motor points; perineum; deep-seated soreness, tenderness and pain in any part of the body; uses of chain, foil, water and all faradic electrodes as means of localizing contact; regulation of dose for definite degrees of action; comparison of this current with faradic, sinusoidal and Leyden jar currents.

Bi-polar and mono-polar water bath methods for the upper and lower extremities. Variations in technique and dose regulation.

Ozone:

Test for presence of ozone; applications with author's electrodes; how to make the dosage efficient; popular fallacies demonstrated; author's special uses of ozone and its value in therapeutics.

How to produce on patients:

Degrees of general or local *sedation* with invigoration.

Degrees of general or local *stimulation* with invigoration.

Degrees of general or local *refreshing* effects with sedation.

Degrees of general or local *refreshing* effects with stimulation.

Degrees of general or local *nutritional, alterative* and *tonic* actions.

Degrees of general or local *circulatory* and *cardiac* effects.

Anodyne effects.

Temperature effects.

Sensory effects.

Vasomotor effects.

Expectorant effects.

Rubefacient and *counter-irritation* effects.

Muscle-contracting effects.

Trophic action on atrophied muscles.

The system of controlling action and effects and regulating therapeutic dosage of static electricity by the operator's eye and *ear* originated in the teachings of Dr. Monell and forms the indispensable basis of skilled technique. Without this knowledge the clinical value of any static machine is reduced to little more than guesswork.

Other important features are: Posturing of patients, comfort of patients, adapting treatment to all fabrics of clothing and different resistances, connecting patient with the prime conductor, relation of metallic articles to treatment, effects of different rates of change, when it is necessary to apply static methods directly to the uncovered skin, the art of self-training, how to practice upon one's self at home without an assistant, and how to develop the full value of this great therapeutic agent.

203. Let us begin by understanding the function and value of the indispensable *grounding*, without which a high potential of static current cannot be obtained. We will also begin the training of the *ear*, and incidentally teach a number of important rudiments, as we consider the subject of grounding.

Start the machine into action with the sliding poles wide apart and without any groundings or connections of any kind. Ignore the general rattle of the apparatus and the hissing of current escaping from the prime conductors and fix the ear upon the *sound* of the *revolving plates*. Note the *quality* of that part of the sound which represents *the pressure of the plates against resistance*. Increase the speed of the plates, and note that in proportion as the speed increases the output of current increases, and the work of the plates against resistance increases. But there is a limit to this ratio of increase. At a definite point speed no longer creates more current. To find this point, drive the plates so fast that they seem to revolve on "momentum" without pushing against any resistance

at all. They *race* round and round, and there is no further increase in the current output. When a horse or man runs within his speed there is energy in every stride, but energy ceases when the man extends himself beyond his limit and is "run off his legs." His muscles, then, do not increase their work, but soon stop, and the man falls exhausted.

So long as speed has reserve *energy* in its work, an increase in the rate of revolution of the static plates drives them with greater force against the "resistance" of the circuit, and raises the E. M. F. When they go so fast that they overtake the resistance and break it down, the limit of E. M. F. is reached and "speed" can do nothing more. Therefore, whether the plates can be made to revolve 500, 1,000, 2,000 or 5,000 times per minute, has no value *beyond the point of maximum potential.* The trained ear takes note of the point of maximum speed and maximum current output the moment it is reached.

The number of revolutions per minute at this point will vary in different machines of the same size in different states of working order, and as between large and small machines the comparison of speed is without value. A few revolutions per minute from a powerful apparatus may easily be more effective than many revolutions of small plates, and this is true without in any way discriminating between different types of static machines.

204. But how can the *ear* be trained to detect whether or not the plates are running against resistance? With the plates at moderate speed, push the sliding poles together so that they short-circuit the current. Now the machine is practically discharged, internal resistance is cut out and the plates "wobble" more freely against the atmospheric layers, from which the *steadying tension* of the electrical charge has been removed. Now vary the speed from slow to fast, and train the ear to the quality of the sound. Next, suddenly draw the poles wide apart, and note the instant effect that the inserted resistance

produces, both on the speed of the plates and on the sound they make.

Training of this kind possesses a many-sided value. It gauges the efficiency of the machine. It indicates when the chloride needs baking out. It takes the place of half a dozen other tests relating to current output. Speed of plates can never be made to conform to mathematics, but must always be regulated to *produce needed effects*, and different conditions will make similar effects depend on very different speeds at different times.

205. The object of *grounding* one pole of the static machine is to create the lowest possible *pressure* at one pole, while at the other the highest pressure is maintained. Without a great difference between the high and low pressure at the opposite poles, we cannot get a current of high voltage, even from the most costly apparatus. Draw the sliding poles wide apart and connect the negative with the wooden surface of the platform at the rear corner. The following series of tests will then show the therapeutic value of creating a wide difference of polar potential and making proper contact with the patient.

Sit yourself on the insulated platform, and with the grounded ball electrode and the plates in moderate action, have an assistant apply a spark to the middle of the thigh. It is not only short and thin, but it strikes a feeble blow. It has very little *voltage* behind it. The current to the platform has to force its way over a couple of feet of poor-conducting surface before it reaches the patient, and is greatly reduced by the resistance between his tissues and the prime conductor. The current from the opposite pole has to force its way to the earth through the general atmosphere, and as dry air is a poor conductor, it reaches the earth almost exhausted. Now, attach a short chain to the positive pole, so that it will drop only to the floor and make the incomplete and partial grounding that robs those who use it of a large percentage of the value of their apparatus. Again apply a spark

to the thigh, with the plates at the same speed as before. Note its greater length, volume and force of blow. Especially train the ear to catch the quality of its sound. The current in this test gets from the pole to the floor by a metallic conductor, but then has to traverse carpet, wood and dry building materials before it reaches moist earth. It cannot run away strong and fast by this difficult route, and hence the potential of the current cannot rise as high as it should for efficient therapeutic use.

206. There is but one way to create *high potential*, and the essential conditions are: (1) A rapid generation of current by the plates; (2) Insulation at one pole, which will restrain escape and develop high resistance; (3) A free path of escape at the other pole, which will reduce resistance to the lowest possible amount.

207. A perfect and complete metallic connection with the earth is the only means of properly conducting the current and providing the *low* antipodes to the *high* pressure of the active polarity. Therefore, now ground the positive pole as I teach that it should be done, and apply another spark to the thigh. Note the increase in volume, voltage and depth of action, and also compare the quality of the sound with the preceding sparks.

But neither *quality of sound* nor *force of blow* yet satisfy the expert operator, and the hissing sounds along the insulated prime conductor are evidence that current is pressing back and passing off into the air instead of coming forward into the patient. The patient and the platform rod should possess an *equal electrical value*. Do they? Reach the tip of your index finger towards the rod and note the spark that passes just before you touch it. How long a spark was it? That depends on the speed of the plates and the amount of current, but every fraction of an inch of spark means that the patient has just so much less charge than the pole of the machine. This is a waste of the purpose of a large machine. It reduces a $400 apparatus to the level of a $100 apparatus, as respects

efficiency of action. Therefore, besides *correct grounding* for the low potential pole, we require *correct conduction from the high potential pole to the patient*, or the circuit will have a gap of resistance in it that will impair its working capacity very much.

With proper grounding secured, now remove the waste resistance on the platform by taking hold of the rod while a final spark test is noted on the thigh. As compared with the first spark, without grounding and proper connection, the result of this last test will be a revelation to all who witness it for the first time. The same machine, with the same speed of the plate, and with but one condition changed from bad to good, shows on the last test of this series the drawing power of a team of horses, while on the first test the impression was hardly more than that of a fly lighting on the tissues.

208. Before taking up the practice of full technique on *patients*, it is my rule to illustrate to physicians *on their own tissues* the nature of the sensations which the static currents can produce. In order to avoid the needless torment of patients, it is essential for the physician to know how all methods of application *feel on himself*, and without this knowledge no one is truly an expert. With an electric motor or any means of turning the plates, no other assistance is required, for you can treat yourself as I have done for years. A useful series of personal tests is as follows:

Start the machine into moderate action, ground the spark ball electrode, take it in hand as if treating a patient and step on the platform. Hold the chain from the electrode handler so that it does not leak off the current. Then test the sensory, muscular and counter-irritant effects of various spark applications. Single sparks on the legs, arms, spine, sides and back of neck, rapid short sparks on the same locations, frictions on the thigh, arm, upper and lower spine and across the lumbar region. These will all be mild sparks, and none of them need be

more than two inches in length. Study the sensations on every part of the body that you can reach, and you will be less likely in future to abuse the confidence of a helpless patient. Next, change the polarity and repeat the same tests. Note the difference between the two poles in every shading of your applications. This study will do much to aid your choice of poles when you are considering the treatment of a new case.

Then take in hand the brass point electrode, and step on the platform. Apply to yourself all variations of breeze, spray, needle sparks, long fine sparks, frictional rubbings, etc., on the different parts of the legs and arms which can be easily reached. Pay close attention to the study of *sounds* as they accompany each action of the current, for afterwards these same sounds are your guide to knowing whether or not you are getting the same effects on your patients.

Now swing out the telescope rod of the head breeze electrode, and sit on the platform under it. In testing head breezes on yourself use my "insulating hand" to adjust the electrode to all distances during the study of accurate dosage. With this useful little contrivance and my electrode handler, I have been able for years to conduct all forms of personal experiments on myself without assistance, and to the hundreds of hours annually spent in this scientific and interesting diversion, must be attributed the development of my special technique, which has become recognized as an original contribution to electro-therapeutics, easily doubling the value of the static machine.

At all times when in doubt step on the platform and refresh your memory as to the action of any particular method, and in time you will be trained beyond the liability of disastrous mistakes with your patients.

209. We now begin our practice for the attainment of technical skill. I assume that my readers have got the general rudiments of the care of the machine, and much

other information from my larger text-book* and I, therefore, begin at once with the study of *skill*, which no other writings contain.

Connect the platform with the negative pole and ground the positive. Make a dummy for use on the platform, which you can spark without torture till you acquire skill. Ground the ball electrode, and, with a strong current, deliver a few test sparks upon a given part of the dummy. Note that these sparks are long, thick, easily kept single, have a low-pitched sound, and go quite directly to the mark at which you aim. For the moment omit any other practice with this spark, and change the electrode connection from the grounding to the positive pole of the machine. Remove the grounding chain from this pole so that nothing will be attached to it but the electrode. Now give the dummy a few sparks about the same size as before. Note the difference in the *sound* of the spark, and the evident difference in *quality* and *voltage*. Note that when you are not in the act of giving the spark, and are standing back from the "patient," the current has no clear pathway of escape to the earth, and backs up in the "dielectric" (air) with the effect of reducing the *difference of potential* between the two poles. Would you consider this a good means of giving sparks? Obviously, it has drawbacks, although it has been recommended by some.

210. Now change the platform to the positive pole and ground the other pole and the electrode in the usual manner. Observe a few test sparks, and you will note that the higher voltage of this polarity gives this spark a high-pitched sound, with the sharp hiss, which means an *irritating* blow; that it does not fly straight to its mark, but is zigzag and erratic; that it is not easy to keep it single; and that it is thin in volume and tends to split. If you next apply this spark to your own tissues the sensation

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is not that of a dull muscle-contracting blow, but is sharp and rousing.

211. Now test the fourth way in which a spark can be obtained. Remove the grounding from the negative pole and attach the electrode chain to it. This manner of connection furnishes what has been called the "direct negative spark," and if you will test it first with the ordinary chain in your hand and then use my electrode handler, you will learn something to your permanent advantage about static electricity.

212. Having tested the four qualities of spark in the above manner, you note that "direct" connection with the *un*grounded prime conductor is poor practice. The sharp negative spark is adapted to states of dull sensation or local anæsthesia, while the qualities required for general use are only present in the thick positive spark, with the electrode and prime conductor grounded. To learn this practically from actual personal tests is a good introduction to the development of your technique in administering sparks.

213. Selecting the proper positive spark with the useful dummy on the platform, now begin to acquire skill in the *delivery* of *all degrees of dosage*. The manner of grasping the electrode, your relation to the platform and the patient, and the patient's relation to the machine, must all be considered and worked out in tests, so that in actual treatment you will be able to proceed smoothly and with correct detail. Hesitation in arranging details impairs the confidence of patients and leads them to suspect the quality of your skill.

Stand well up over your work where you can see what you are doing. Never stand off as if you were afraid of the apparatus. Support the weight of the electrode with the left hand. Press the left arm close to the side with the elbow flexed and the forearm brought midway towards the right shoulder. Almost all the manipulation of the left arm will then be at the elbow joint. In the right hand grasp the electrode between the thumb

and three fingers, using only the last phalanges, with the hand as nearly open as possible. Never shut the fist on the electrode or grasp it tight. The manipulation of the right arm is nearly all in the wrist and in the finger joints. The upper arm is held against the side for the most part and makes very little movement. The electrode handler then joins the two arms in a common and interdependent action, so that *both move together in supplementing harmony.* By this manipulation all labor is removed from the direction of the electrode, which I hold as lightly as a pen. No one can proceed far in skill unless he first masters the great art of co-ordinating the two arms, the electrode and its supporting handle, till they move as one. I do not know how to put the knack of it in words, but an object-lesson makes it very plain. Practice it with the ball electrode as we study the technique of sparks.

214. Using a current-strength that will give a four or five-inch spark, first aim to apply one at a time on a given spot, without any duplication or splitting. When you can give one clean spark at a time, practice regularity at all rates from one to five sparks per second. *Regularity of administration* is of great importance, for the tissues learn to expect the next spark at an equal interval, and if the interval is irregular, the tissues are apt to get "nervous."

215. The next thing to acquire is the art of "rhythm" in the application of general sparks. The tissues are quick to discern *rhythm* in the "time" of sparks, and adapt themselves to an expected "time" with a composure that is in remarkable contrast to jerky work with the same sparks. Take any marching tune and keep step to it with the electrode and the sparks. Practice a number of variations, as:

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These dots set to music will give you the idea, and you can work it out on the dummy till *rhythm* is second nature. The difference to your future patients will more than recompense the cost. By *correct dosage* and *rhythm* combined all ordinary sparks may be made acceptable to tissues that *need* them. A bungler can torment a patient with a treatment that should be in no wise disagreeable, and if you wish to make sparks please your clients administer them set to music. But also practice what I call, for want of a better word, the great art of "letting up." Don't persist too long with sparks; let up! Give your patient a breathing spell between the bars of your tune. Make your treatment effective—but make it gentle.

216. Now we have seen that the positive spark is thicker than the negative, because the lower voltage of the negative pole to the platform allows a greater *accumulation* of current before the *tension* breaks down in the discharge. But we can make the positive spark long or short, thick or thin, single or multiple, sharp or dull, a fusilade or a certain rhythm. These variations are part of the art of dose regulation.

Start the machine very slow. Hold the ball electrode as near as possible to the dummy without giving a spark. Then press it just forward, and practice giving slow single sparks with the electrode almost motionless on the border line. Increase the speed of the plates a little. Note the effect upon the voltage and volume of the spark. Draw the electrode back a trifle to again mark the border line of sparking distance. Again increase the current, and note the advance of dosage till the spark is at its greatest length. Reverse the tests and run the dosage down. Afterwards, when you begin to treat a patient, you will be able to regulate the exact length of spark that will produce the effect you wish. Make it a rule to first know what effect you wish to produce, or else "quackery" will be the term to apply to the treatment.

217. Having practiced the control of sparks in this

general way, we will next attempt to apply them exactly where we wish on all parts of the body.

In this book I make no mention of *indications* for any form of static current, as that part of the subject is all contained in my other works. Assume that we have a patient on the platform who stands in need of sparks on the forehead, or sides of the nose, or eyelids; how shall we apply them? Take the author's fine needle-point electrode, and just as you start the machine into very slow action, step quickly to the side of the patient and bring the point up to the border line you have become familiar with by your practice on the preceding page. When the point is in position, practice small, neat oblique side sweeps of the electrode from just beyond the sparking distance to just within it. Allow an interval and repeat. Know what you are using the sparks for, and then make them produce the desired effects. When you can do this you have conquered *skill*. But you must be able to make the spark merely muscle-contracting, or sedative, or stimulating to the tissues or circulation, or counter-irritant, or pain-relieving and refreshing, as may be needed by the case. Can you yet do it? If not, practice till you can.

218. The eye muscles and the vascular and nerve supply of the eye may be often benefitted by proper sparks. Take my large copper-needle electrode, and unscrew the top, leaving only the single fine needle in place. With a slow speed of the plates and the right knack of "throwing" a spark where and when you want it, a case of exophoria can be efficiently corrected, or an eye tired from strain, or irritated, or asthenopic, can be made to feel like new in a moment. I have applied sparks to the eyelids of babies, children from five to ten years of age, and adults, and with satisfaction to all. My students are aware that I never hurt a patient that I treat myself, and sparks do not hurt upon the eye when they are applied by me.

219. And right here is a fitting place to emphasize a point in *dose regulation*. Sit upon the platform yourself, and have an assistant start the machine into *rapid action*. Let him approach the eye with the electrode as if to deliver a single spark upon the lid. Would you sit still or would you dodge? Yet many physicians never vary the speed of the plates during office hours. Every spark, breeze and spray is administered with the same maximum E. M. F. Try it a few times on yourself, and I think you will learn to appreciate the great value of *discriminating dose regulation*. No one who uses the static machine always at a high rate of speed can be considered an expert operator. It is abuse, and crude, bungling, charlatanism, rather than reputable medical practice to employ an electric current at a routine of its *highest voltage*. The command of every rate of speed from the maximum down to a standstill, is as indispensable in static work as are different degrees of temperature in the use of heat.

220. Sparks are easily applied to all muscles of the cheek, neck and larynx, and are varied in dose by a choice of three electrodes. The fine, or coarse, brass points, and the regular ball each have their uses.

With the finest point practice the most delicate needle sparks, single and multiple, and also learn to throw a thick long spark with this same electrode. The first thing to study is the exact border line at which the electrode can be held before a spark flies. It varies according to the *voltage* of the current and must be mastered before going further. In reaching the parts about the neck with sparks it is correct technique to approach the point slowly to near the sparking line and then with a short quick movement of the wrist throw the desired quality of discharge from the electrode to the tissues. Test all degrees of current-strength and especially note sensations that are produced on the different tissues.

221. Now take the blunter point and note the fuller "needles" that discharge from it to the same tissues with

the same degree of current-strength. Practice slow and single but small sparks from the lowest to the highest voltage needed in these parts, and also learn to throw almost as long and heavy a spark from this point as you can obtain even from the ball.

222. But now take the ball and study how you can skillfully direct mild sparks to the muscles of the throat with benefit to the patient and with perfect tolerance. Imagine that the machine is in rapid action and the patient charged with a high voltage current, could you then apply a moderate spark from this brass ball to the motor point of the sterno-cleido-mastoid? It is very doubtful. If you were on the platform yourself and the attempt was made, you would probably *dodge*. But stop the machine and place the ball of the electrode exactly on the motor point before there is any current at all. Then slowly revolve the plate so that the voltage remains low. As the current charges the patient lift the ball an inch from the tissues and quickly again throw it down to contact. One, two or more small sparks will pass while the electrode is in the air, according to your knack of making and breaking the contact, but with a little practice it is possible to apply just the sparks you wish and no more. You can control their length by the distance to which you raise the ball, and the "let up" is obtained, not by drawing away the electrode, but by resting it a moment on the bare skin. This spark can be given a beautiful quality of *counter irritation* by the addition of dry resistance between the tissues and the electrode. It is splendid practice to control this kind of spark and it develops confidence in the operator which the patient will afterwards enjoy.

Study the principles which govern the control and regulation of sparks, and associate *action*, *sensation* and *sound* together, so that in all administrations you will know what the patient *receives* and *feels* without asking.

223. Now take the region of the chest. Test on your-

self the points of special tenderness and note where tolerance is best. Rarely use the large ball for sparks on the chest except for special *counter-irritation*. Take the blunt *point* and practice throwing short but quite thick and muscle-contracting sparks from it to the respiratory muscles during *inspiration*. Note that on a *rib* the blow of the spark is much sharper than when the muscle only is struck.

224. Sparks upon the sole of the foot call for some degree of care in cases with normal sensation. The bottom of the shoe must be *dry* or the discharge will conduct off in the form of a spray instead of a disruptive spark. Have the patient rest the foot on the heel with the ankle joint in mid-flexion. On the platform under the ball of the foot rest the spark electrode. By having the patient raise or lower the foot you can control the length you wish the spark to be, for it will measure the distance between the top of the electrode and the sole of the shoe. Now start the machine into the rate of speed that will give you the desired dosage and with a quick movement throw the electrode toward the sole till the spark flies and instantly return it to contact with the platform, where it will leak off the current and prevent its discharge to the foot till you again lift it. Sparks upon the sole of the foot are quite a different matter from sparks around the dorsum and ankle, which require a different technique altogether.

225. If the case has the numbness of locomotor ataxia and similar states of impaired sensation, these moderate sparks are not indicated. Instead we charge the patient fully, lift the foot clear of the platform with the sole toward the operator, and with a strong current deliver thick and full percussive sparks upon the center of the plantar muscles. The number that are to be applied at a sitting will depend on the needs of the tissues. So long as full warmth and sensation is undeveloped keep at the tissues till they respond. When the patient at last says

it "feels good" and the sensation has become keen, you can stop.

226. All common tests of sparks I leave you to make alone and will next speak of the control of *moisture on the skin*, which prevents a full spark. In summer one of the difficulties met with by new operators is not only the effect of dampness upon the *machine*, but its effect on the discharges to the *patient*. Few physicians understand this or know how to obviate the trouble. To illustrate what I mean, let us manufacture the conditions of a hot summer day. Put a patient on the platform with his sleeve rolled up and wet the skin with warm water. Now try to give the usual spark. Wet a thin towel and wrap around the arm and again try to apply a good thick spark. Why do you fail? Because water in even the small quantity of gentle perspiration is a *conductor* of electricity and the current is conducted from the electrode to the arm too rapidly to permit the *accumulation* of a spark. This accumulation can only take place when the current is held back by non-conducting (dry) resistance till the requisite *quantity* breaks down the limiting *tension* and the discharge is the sudden spark instead of the gradual spray. Therefore dry the patient's arm again and if necessary add toilet powder, so that the surface is resisting instead of conducting. Now try the spark and note the difference. If clothing is damp so as to interfere with your application in the summer, you can extend the same principle to meet every condition of moisture that is local to the patient. If the machine is damp and *cannot be dried* the presence of the vapor of water acts as a conductor and the current will not *accumulate*. A sieve will not accumulate water and wet air is the same as a sieve to the static current. If the machine is fairly dry, but the *air of the room* is temporarily filled with dampness from a fog or great outdoor humidity, the same conducting capacity of water will carry away the current as fast as it is generated by the revolving plates, and very little can

be held back on the *platform* for therapeutic use. *This principle applies to every static machine that was ever made.* The type of machine has nothing to do with it. Moisture will conduct and dry air is the essential dieletric, and the repeated claims made to the contrary in behalf of certain types of static machines have no foundation in fact. No apparatus has any advantage in this respect over any other, though many suppose that there is a decided difference. What I here state is not a matter of mere opinion, but is the demonstration of tests that any physician can repeat.

Sometimes the Quixotic exploits of ignorance of this simple fact are truly laughable when we reflect how slight an amount of knowledge would save the disappointment. Such an instance was the fitting up of a hospital ship during our war with Spain with a static machine for X-ray work. As well tell the surgeon to put his antiseptic solutions in a sieve and blame the sieve for not retaining them for use as to expect the moisture-laden atmosphere of the rainy season in Cuban waters (out of the sun) to act as a dielectric and *insulate* a static current. The fault was not with the machine, but with the *conditions.* Wet wood will not burn, but *dry* wood will make an elegant fire. A wet static machine and wet air will not develop a high voltage current, but a dry machine in dry air will do its part if the operator does his. If an expert could have corrected the conditions he could have done work in Cuba.

227. The art of imparting to sparks the exact *quality* desired to meet the patient's indications should next be studied. The *quality* of sparks has more to do with their therapeutic action than mere *length*, although many seem to think that the terms "long" and "short" measure the curative properties of the static spark. In the summary of my clinical teachings on a previous page will be found the list of spark dosage, which you should practice. Your

results will improve in proportion as you became able to dose sparks as accurately as you dose strychnine.

228. We next pass to what are called "frictions," or "frictional sparks." They are familiar to all who have a static machine, but refinements of dosage and method are not so familiar and these require practice to develop. Any electrode may be used, but the ball and blunt point are of the greatest service. The satisfactory application requires:

1. Proper initial contact of the electrode without hurt or annoyance to the patient.
2. Exact quality of dosage according to indications.
3. Precise duration of action to secure effect.

Incompetency can make frictional sparks torture. They can be abused in various ways. They can wholly fall short of their intent and have no therapeutic action whatever, or they can fail of permanent results by some slight inadequacy of dosage when all else has been *secundum artem*. The difference in sensation and effect between frictions from an expert and from the untaught physician is one of the most astonishing surprises that can be administered to a patient. No one would believe that the "same thing" could be so absolutely different. To tissues that need them "frictions" should be grateful and "feel good." My students have often heard patients remark: "That is like a drink when you are thirsty"; "it is like food when you are hungry"; "I cannot tell you how good that feels," and so on.

My students also note that my patients all sit calmly still and welcome the treatment. There is not only no dread of torment, but there is often eager desire for the application, and if it is omitted from the seance regular patients will remind me of it and say that it did so much good they would like it repeated.

229. There are three ways of commencing the application. Which one I use depends upon the case. Test

each method so that you will know on what a choice depends.

1. With the machine at a standstill place the electrode in contact and as the current-strength advances to the desired dose begin the treatment.

2. Start the machine into action and quickly step to the patient and make contact before the current develops a charge. Both these methods avoid startling the patient with a spark while applying the electrode.

3. With a full charge of current make a quick glancing stroke of the electrode so that it reaches the tissues with but one discharge. Avoid letting two or three sparks annoy the patient while you are securing contact.

Test on yourself the effects of different *rates of change* of the electrode. Move it slowly till you have learned enough about the action of *slow* frictions with a high potential current to satisfy you. *It will not take long.* Then test more rapid rates of change and also vary the *length of sweep* given the electrode over the tissues. Note also the great differences that depend on *pressure.* Read what I have said about *pressures* and *rates of change* in the galvanic and other chapters, and apply the same *principles* to static electricity. I have found it difficult to train students to govern pressure in employing frictions upon certain uneven surfaces of the body, but the results depend very largely on the quality of your pressure and practice ought to perfect your skill.

230. But there is another element which plays an important part in the development of dosage in static frictions, and this the quality and amount of dry resistance between the tissues and the electrode. This condition is at all times under the control of the operator. Whether winter or summer there is no need to fall short of your desired dosage *if you know what it is.*

There is also another variation in technique which is an indispensable part of skill. Test, therefore, how you can, when needed, intensify the effect by lifting the elec-

trode from close contact and increasing the voltage and volume of the *needle rain* that pours down on the tissues from the rapidly moved surface of the electrode. This addition of intensity is under the exact control of the operator and is at command when indications require.

231. But how can the physician who is aiming to set up a *counter-irritant* action upon the cervical spine know that he is doing it and know when he has done it *enough*? Should he let the patient tell him? By no means. Has the average patient enough medical knowledge to be the judge of dosage? Not at all. The trained *ear* of the operator measures the amount of action and notes the quality. The *sound* of the fine stream of sparks tells all the story. It will tell you if the resistance is too little or too much, and when it is just right and has been maintained long enough the limit of tolerance is identified by the tests for sound and sensation which you have previously practiced on your own tissues. It is as exact as a druggist's scales. My students have often heard patients say: "Doctor, you know *when to take that electrode off* better than I could tell you." When you reach this stage of skill your patients will not question your results. The instruction of experience will be found invaluable in this technique.

232. The spark is the sudden discharge of current which has accumulated under conditions which hinder free conduction. The breeze and spray represent a less sudden *rate of change* under conditions which favor the gradual discharge of current without intermittent accumulations. One is something like the even pressure of a hammer upon a tack; the other is a blow of the same hammer which drives the tack to its head. All the variations in local static treatment are variations in the *rate of change* of discharging the current through the tissues. The degree of rapidity of the discharge, together with the amount of it, is the *dose*. How the *rate* at which a current passes through a part can affect it so variously will be bet-

ter understood if we imagine, for instance, a warehouse filled with grain. At the discharge shute we can study rates of change and the comparative disturbance in different parts of the stored grain. At the extreme outlet there is the rapid rush of the swift discharge and the evidence of centrifugal attraction as the grains fly onward, the kernels standing apart and scattering dust from the shute. High up in the bin an opposite action takes place. The kernels fall irregularly against each other in slow descent. In a farther corner they begin to stir only after many bushels have poured in a torrent through the shute. Along the entire line of action may be studied many grades of motion on the mass of grain. The suggestion is sufficient to open up the thought. In the application of static electricity simple electrification produces the slowest rate of passing the current through the tissues. The breeze increases the rate in proportion as it is intense, and the spray discharge localizes a great increase in the rate, which reaches its maximum in the spark. We will now practice the variations of the breeze and spray.

233. Connect the positive pole to the platform and take the single point electrode. With the machine in full action and beginning three feet away from the forehead, gradually approach the point to just short of sparking distance. Note the sensations at the different distances and observe that the current appears to be very strong up to a foot or so from the frontal region and loses its coarse quality and becomes cool and bland as the distance reduces to six inches and less. Reverse the poles and note that with the same test the current gets stronger all the way up to the sparking limit. In the one case there is no spray discharge and in the other case the familiar violet spray is prominent. With one pole the sparking distance is four, five or six inches if the current is strong, while with the other polarity you can bring up the point with impunity to within an inch. But test the same things on the thigh or spine. The apparent action contradicts

what you have just learned. The negative spray now has its own luminosity and it also gets stronger all the way up. There is no *contradiction* and the explanation is simple. It is simply the difference in conditions. The principle of the influence of dry resistance which I have sufficiently dwelt on elsewhere is the whole key to the "mystery" that perplexes so many beginners.

234. Now, with each polarity in turn test and master the exact sparking distance with each electrode and with all grades of current-strength. This is of fundamental importance, for patients do not want to be surprised with sparks when you intend only a spray. Study the *appearance* at the point of the electrode, which warns you that a spark is about to jump and learn to at once draw back the electrode so as to avoid it. Also practice the art of "coaxing" up the electrode by very slow approaches to a much closer action and stronger spray than can be obtained by a quick approach. The current must *slide* off the electrode to remain a spray, and not be thrown from it by too abrupt changes of its position.

235. Without doubt the scientific use of the immensely flexible form of discharge which is called a *spray* requires more skill, more knowledge of dose regulation and control of conditions, than any other technique in electro-therapeutics. The spray is more difficult than the spark and its full capabilities are little dreamed of by the average physician. No student has ever come to me with a previous knowledge of spray dosage, no matter what other instruction he may have had. Physicians to whom my technique has been a revelation of the value and scope of spray action have over and over again remarked that the idea cannot be got out of a book. "Unless they see you do it, no one can understand it," has been the general verdict of witnesses, and hence, I shall not expect to here paint in words a picture that can be seen with the eye. I can only say, practice wrist movement, study actions, test every sensation, and apply the established principles

of conduction, resistance, rate of change and localization to the production of spray effects.

You may be unable at first to secure the exact dosage you desire, but study the reasons of failure and the next time it will seem easy to succeed. As an instance of the great difference made by technique with the electrode in the effect of the same current, method and dosage, I will here cite a recent remark of a patient to whom I was giving sparks for demonstration. After illustrating the proper rhythm and delivery of single sparks for tonic action on muscles, a student took the electrode and without any change in any respect tried to duplicate my sparks. On his asking the patient whether they were the same or not, she said: "Your *hand is heavier* than Dr. Monell's." The physician grasped the idea she attempted to convey, but until that moment had not thought that the technique of the hand had any influence on the sensation of a spark which was thrown to the tissues without touching the patient at all. But he soon realized that it had. And so it has with the action of the spray. A spray can be applied to a recent case of brachial neuritis with the effect that the arm rests powerless and heavy on the patient's lap. Another *dosage* of spray can then lighten the arm, refresh it and restore power and temporarily remove the pain. After a tiring treatment of the muscles a spray can be applied by a novice for half an hour with little restful action, while I can take the same electrode and make the arm light, strong and buoyant in a couple of minutes. It is all a matter of technique. The *principles* are the same that lead the operator to the right use of the galvanic or faradic current, and are neither obscure nor wrapped in mystery; but so little has the medical profession studied the subject of static electricity that it is regarded either as a *terra-incognita*, or the view is held that there is "nothing to learn about it." Both of these views are negatived by experience.

236. An important part of the technique of applying

intense and concentrated sprays in such regions as the auditory meatus, the inner canthus of the eye, the nares and wherever exact localization is required, is the position in which the operator stands and holds his electrode. As the machine starts and the current advances to a full charge of the patient, step near the left front corner of the platform and present the point of the electrode toward the part we are to treat, say the right eye. Advance the point in a line midway between the tip of the nose and the outer canthus, so that it avoids all projecting attractions which would draw the spray. Now lean one leg firmly against the edge of the platform to brace you in a steady position so that you can hold the electrode without tremor. With the ear on the sound of the plates slowly move up the point till the violet pencil discharge pours full upon the lid, and then shift it to the exact spot you wish to treat. Support the electrode with the left hand, direct it lightly with the fingers of the right, and combine a pull upon the "handler" with a forward push upon the electrode that will steady it and make its manipulation easy. The advantage of a "brace" against the platform will be appreciated by any one who tries to hold a delicate spray upon the orifice of the lachrymal duct without it. In all my local applications except long sparks it is my rule to stand well up near the patient and against the platform to make the work as easy as possible. Does not this leak off the current? My students are aware that *no question of leakage of any kind* ever enters into correct static technique as I teach it. The physician who does not know how to make his electrodes take care of "leaks" has yet to learn the first rudiments of static electricity. With the electrode you control the discharge as you wish it, you regulate the speed of the plates as with a secondary *rheostat*, you short-circuit the current when you wish to touch the patient without stopping the machine, you protect the patient from irritation in the intervals of treatment, and it is your weapon of offense, defense and

control. To the expert it is a veritable wizard's wand. Like the baton of the leader which directs every tune the orchestra plays, the static electrode in the hands of its master dominates the whole electro-static field. Its function is far greater than the electrodes of the faradic current. It is the regulator of current-strength, the final arbiter of the dose, the creator of the *quality* in every action of the current and the responsible cause of your therapeutic effects. This current has little intrinsic *local action* of its own. Its effects, as I have pointed out elsewhere, are the products of varying the *rate of change* in the tissues, and the rate of change is the creature of your electrode. Study its manipulation with nicety. Do not stop at coarse technique, but study refinements of action till you can make the spray sing a zephyr lullaby to woo the ache from weary tissues, or with martial music stir them to tonic action, or pour down if need be a rubefacient sandblast to set up an active counter-irritation. Study the different therapeutic effects that vary with bland, cool, warm and hot sprays, and sprays interspersed with all gradations of needle sparks.

237. Under all circumstances, at all seasons and through all varieties of fabrics ranging from the gossamer shirt waist of July to the woolen wrappings of December, the indicated *quality* of static sprays and frictions can be exactly dosed in every case by study of three things:

1. The adjustment of resistances.
2. The regulation of current-strength.
3. Correct technique with the electrode.

Make every test which will give you command of these. The *quality* of any spray is indicated by its *sound*, and once the ear is correctly trained you thereafter know precisely what you are doing to your patient without asking how "it feels." Read the list of spray applications in the first part of this chapter and practice till you can duplicate it. Remember that the "keynote" of spray work is "*local concentration.*" "Diffusion" is the common error of untaught

operators. Make a simple series of tests on yourself with the "umbrella" head breeze electrode and then contrast the more efficient breeze from my own electrode. The demonstration will teach the general principle. I have not used an umbrella electrode on a patient in seven years or more, and its employment by any one at this stage of progress is proof that he has not learned how to do better.

238. Another important point of contrast in the use of sprays is the fact that besides the division of polarity they are clinically divisible into two other great classes as follows:

1. The effects are the product of the spray and the electrode serves merely to place the spray where it can act. The electrode plays a *passive* part.

2. Effects are the product of the technique of the active electrode which modifies intensity and rate of change. The spray is neutral *until the technique makes it therapeutic.*

There is so much to this subject of static sprays that in writing about actions, qualities, dosage and the electrode-juggling which is involved in skilled technique, one is baffled in attempting to turn words into a demonstration. A jeweler with a glance of the eye can separate scraps of old gold into 14k., 12k., 10k. and 18k. qualities as fast as he can handle them with a pair of tweezers; but imagine writing a letter to a farmer to do the same thing. The appearance that tells the expert that a bent and twisted ring is 12k. instead of 14k. cannot be described in language, so also my readers must recognize the same limitations in a description of degrees of static sprays. By study (with the aid of such help as books can give) the average physician who will devote an hour or more to daily experiment ought to become fairly expert in from five to eight years, depending on his natural aptitude and manner of study. Probably seventy per cent. of this time can be saved by actually seeing the demonstrations at the *beginning* of your experience. The economy of proper in-

struction at the start is about the same in static work as it is in music.

239. At this point I shall consider the *ozone* application, which is an electrolytic result of passing high-potential electricity through either air or water, or both. In your medical library read up the *properties and actions* of ozone before using it. I do not find that its therapeutic value is much dwelt on in any medical literature. It should be antiseptic, disinfectant, tonic and alterative. It is irritant when concentrated, just as a strong brine is irritant, but we have only to recall that a normal salt solution is sedative to an irritated mucous membrane to grasp the principle of dosing ozone for medical effects. From questions asked me by students I infer that there is abroad an overestimate of the utility of ozone as generated by the static machine as well as a very crude use of the apparatus. Some appear to think it is recommended as "a cure for bronchitis, consumption and all diseases of the respiratory tract." Along with this belief it has been offered as an inhalant by such inefficient methods that its action could scarcely have "cured" anything, much less a formidable disease like phthisis. One of the drawbacks to a statement of the physiological actions of static electricity is that the average practitioner takes the statement *without the technique*, and his expectations of getting the same actions on diseased tissues are not based on a knowledge of *how* to produce them. This is especially true of ozone effects.

One of my patients with an old pharyngitis recently told me that Dr. —— held a brass point electrode about a foot in front of her face with her lips closed and told her that she was now getting ozone, which would benefit her throat greatly. It is difficult to turn from his statement to his practice and do anything but laugh. Yet to the deluded and confiding patient who paid the fees and wanted to have ozone "benefit her throat" it was anything but a laughing matter. All over the country doctors are

daily doing similar inefficient things with static apparatus and either imagining they are producing results or wondering why they don't.

But to proceed: In France some eight or nine years ago a special ozone generator was put on the market for use with the static machine and with slight alteration has since been made in this country. It affords a spark discharge within a glass bulb and the ozone is inhaled after being mixed with oxygen or compressed air. When this device is employed the patient is not electrified and is undergoing no *general* treatment as by my own method. The application is not flexible, and granting it its full due of credit no tests that I was able to make with it were equal to the direct ozone spray as I have long employed it.

In certain conditions of the nasal mucous membrane the ozone spray is a sovereign remedy, but that it has any value when inhaled in diseases of the chest I cannot demonstrate and believe that my other methods are far more efficient. In fact, the ozone action seems to me to be expended upon the tissues it immediately reaches, and I do not prove by any test that it remains nascent ozone and reaches down into the pulmonary tract and exerts there anything like the same healing action it exerts upon the local tissues of the surface that it can be poured directly upon. I consider it of specific value in one field of action. I can make it allay the irritation of any inflamed part it can reach, can deodorize suppuration and heal an old ulcer, and radically cure hay fever with it and a little other static, and during the last three months have with it reduced a large epithelioma of the tongue to a remnant about a tenth of its original size. The palliation and relief of this case I shall relate elsewhere. But I cannot feel that I do anything but waste time when I attempt to treat bronchitis and tuberculosis with inhalation of doubtful ozone while I know that *I have far better methods at command.* In these diseases I can do more with static elec-

tricity than any other remedy can do for the patient, but it is not in the form of ozone that I use it.

To effect ozone action upon the nasal mucous membrane, charge the patient with the negative pole and take in hand the author's small needle spray electrode. Have the patient close one nostril with pressure of a finger tip and snuff up the discharge as you direct it into the other nostril in the strong violet stream of a concentrated spray. The electrode will be about one inch from the tissues and in an oblique direction. The art of avoiding a spark must be cultivated by experience. So also must the knowledge of whether the discharge is properly dosed and is efficient or not.

Repeat on the other side in the same manner. In reaching other morbid tissues which the antiseptic and healing action of ozone will benefit the operator must get the nascent discharge full upon the part, for it will not benefit what it does not touch. To reach far back in the mouth in the case of epithelioma was not easy at first, as the patient could hardly part the teeth, but a little practice soon enabled me to do it.

240. Now to test whether this static discharge is really a generator of ozone, pour a few drops of a ten per cent. solution of iodide of potassium on a piece of blotting paper laid on the charged platform. Test the comparative rapidity with which iodine is freed by the positive spray, the negative spray, sparks and by different doses of each. Note that all discharges will develop the chocolate brown of iodine as it is freed from the white solution of K. I. But one discharge frees it faster than any other, and we note that the positive spray in its most concentrated form does this. Remember this when therapeutic dosage is in question.

When you have mastered the art of energetic action with this spray of *nascent ozone* you can make it more potent in cases of lupus, tuberculous lesions of the skin and chronic ulcers than any surgical resource that I have

ever read of or seen employed. Judging from reported cases, the action of *ultra-violet light* concentrated by lenses is in the same direction, but slower and feebler. So also seems to be the action attributed to X-rays in the treatment of these morbid states, but in flexibility, control of dosage, ease of application, immediate symptomatic relief and rapid and permanent results it is certain that in my hands the ozone spray is very much superior to the two above mentioned forms of treatment. As I write these lines a typical case for ozone spray comes to my notice in the daily press. Omitting names, the report reads thus:

"M———, N. Y., July 18.—Mr. ———, one of the directors of the ——— company, is confined to his country home at ———, suffering from a growth on his right cheek caused by an ulcerated tooth. More than two months ago an abcess formed near the eye tooth. Dr. ——— cut out the growth, but the wound failed to heal. A few days ago a consultation was held between Dr. ——— and specialists from Philadelphia, New York and ———. Some of them advised a second operation, while others thought that it was possible to cure the patient by another kind of treatment. At present the treatment suggested is being tested, as the family does not desire a second operation if it can be avoided. The whole trouble, it is said, was brought by neglect of a tooth, which ached for several weeks. Mr. ——— is up and around, but at times suffers much pain. A trained nurse dresses the wound daily, while Dr. ——— comes all the way from ——— twice a month to examine his patient."

This is (whether malignant or not) a case for the ozone spray. It would remove the *pain* instantly and would at once palliate all the disturbing symptoms. It would at once set up the process of healing by granulation and in a week would make a radical change in the condition of the patient. If not malignant, he would rapidly

get well without any inconvenience or delay. If it proved to be malignant, he would obtain a kind and degree of palliation that nothing else in surgery or medicine could furnish. My sufficient excuse for intruding mention of this case here is the occasional occurrence of somewhat similar cases and the fact that a knowledge of the efficient remedy which I here report would relieve the perplexity of the consultants and rescue the hapless patient from needless suffering and despair. In the case of the financial magnate above referred to the mere business consideration of quickly returning him to the control of his affairs would justify sending a machine and expert operator to his residence if he lived a hundred miles from the nearest physician who knew how to use the apparatus.

241. I shall now discuss the so-called *static cataphoresis*, which has been revived in the United States during the past year, with an attempt to exploit its imaginary properties for sensational purposes. It is an important subject chiefly because of the newspaper advertising it has received and to it I invite my readers' careful attention. *Cataphoresis* signifies the administration of drugs by pushing them in solution through the skin of the patient by the osmotic action of one pole of an electric current of an unbroken flow, considerable volume and sufficient voltage to break down the localized resistance. But one current provides the conditions of flow and volume which establish osmosis through the skin, and that current is the *constant* galvanic. All other currents are *interrupted*, or broken, in circuit. With this premise let us see about static cataphoresis.

The same generation which witnessed the invention of the Leyden jar was startled a few years later by the assertion of a European monk that he had placed a sealed glass jar of Peruvian balsam by the side of a patient and upon discharging static electricity in a certain manner had driven the balsam from the bottle into the pa-

tient with the most miraculous results. The news was "important if true," and it was accepted as true by many credulous people till some one put it to the test and exposed the fraud. It was not then called cataphoresis, for the term had not been invented, but it was the first attempt on record to accomplish cataphoric medication, and only failed because the current lacked a continuous flow of ten or twenty miliamperes. The idea lingered out the last century, however, and many experiments continued to be made. When *electrolysis* and *cataphoric action* were demonstrated with the galvanic current about the middle of this century, amperage was not understood, and it was thought that the high voltage of static electricity ought to do the same thing. As I have cited in one of my other books, Arthuis, of Paris, in 1871-2, put forward the idea that he was treating his patients with metallic drugs, such as iron, silver, steel, gold, copper, brass, mercury, etc., by holding electrodes of these metals near the tissues with spray discharges of the current. Perhaps he was for a time deceived by the plausability of his theories on the subject, but no competent investigator can read his writings and demonstrate reason for his faith. Take your own static machine and now ascertain the facts.

242. Pour a few drops of ten per cent. K. I. solution on a blotting pad with an enameled back through which the fluid will not soak by ordinary absorption. Place it on the static platform and apply a positive spray till the area of solution turns a deep brown. Stop the machine and pull apart the layers of the blotting paper. Note that none below the top are brown. Note that no fluid is driven through the enameled backing of the blotter. How far has the current pushed the free iodine into the tissues by osmotic actions? Has there been any osmotic action at all. Now pour a few drops of the same solution on the forearm just above the wrist. Hold the arm so that the fluid will not run off.

Apply the same spray till all the free iodine is evolved. Then wipe off the solution. Note that the slight discoloration on the surface of the skin wipes off at the same time to an extent that proves a lack of absorption into the skin.

Now cover the blotting paper with the palm and through the thickness of the hand try to evolve iodine with the static spray. Not a bit appears. The evolution of iodine from the solution *depends on the contact of ozone with the K. I. solution* and the spray does not even drive the *ozone* it generates itself through any resisting medium between it and the K. I.

243. Now make a control test. Take eight layers of white blotting paper. Between each place a layer of linen-finish writing paper. Also at the top and bottom of the pile. Wet all in the usual bicarbonate of soda solution. Also wet two electrodes covered with chamois skin and on each pour ten drops of compound tincture of iodine. Make contact with the electrodes so that the pile of prepared paper will be between them and complete the circuit. Hold the contact for two minutes without any current at all. Now see if the iodine has penetrated to the blotting papers. Next start the current action and pass 15 mil. for five minutes. Note the result and from it learn two lessons. The iodine at the negative pole shows through the outside non-absorbent writing paper and also through the next layer of blotting paper. Note that at the positive pole it has disclosed only the outer surface of the outside writing paper and there has been no *osmotic* penetration. You have proved that the cataphoresis of the iodine is due to the current, for your contact without the current caused no absorption, and you have also demonstrated that iodine is driven away from the negative pole. Now repeat the test with two non-absorbent layers of writing paper next to the electrodes. Pass twenty mil. five minutes and continue five min-

utes longer with fifteen mil. Note that the iodine at the negative pole has now been pushed through the two outer layers of non-absorbent writing paper, saturated the first layer of blotting paper and appears on the proximal surface of the next layer of writing paper. Note that at the positive galvanic pole the iodine has not been pushed inward at all.

Now repeat exactly these tests with every static spray, polarity and dosage that you can produce. Test also other kinds of static discharge. Can you push iodine with any of them so that it shows below the contact of primary diffusion? Some of these tests ought to demonstrate some degree of *static cataphoresis* if there is any such thing. Can you show anything resembling the galvanic action of amperage? I cannot. But let us see what others are saying about this thing.

244. In a recent medical journal appears a short article on "Static Cataphoresis," by a writer holding a professorship in a college of electro-therapeutics in a neighboring State. From this article I will cite the statements, which you can put to practical test and determine for yourself whether or not they are well fortified by the facts:

"As static electricity is of sufficient high electro-motive force it is capable of exciting molecular motion in gaseous substances, the same as the galvanic current imparts molecular motion to liquids and substances held in solution. The cataphoric action of the galvanic current arises from the mode of molecular motion it imparts to the substance applied, and it is now found that the static current possesses the same, if not more, marked properties in relation to gaseous matter; the molecular structure of gaseous matter being so much finer, and the molecules being held in a more mobile state, greater power of penetration is given when bombarded against the surface of the tissues to which it is applied.

"This is found applicable to the use of volatilized mer-

cury, from formaldehyde, etc., which may be administered in the following manner:

"Take a glass globe or vessel having an opening which will fit closely to the surface to which it has been applied; at the other end have fitted a metallic brush for admitting the static current; upon a glass rod sealed inside the chamber is placed cotton or sponge saturated with formaldehyde or any other substance which will evaporate and saturate the air contained within the chamber, and a static discharge sent from the brush electrode through the saturated air chamber to the skin of the patient, over the part to be treated by this method.

"The medicine can be volatilized by heat, outside the vessel, and carried through a glass tube sealed into it, if desired.

"It will be readily seen that any gas admitted to the glass vessel or chamber would be excited by the static discharge, broken up, decomposed to a certain extent and driven against the tissue, a cataphoric action then taking place of great penetrative power.

"This static cataphoresis can be used for many purposes, especially in pulmonary ailments. I predict a great future for static cataphoresis."

"In a daily New York paper, January 14, 1900, it is stated that for a month past the ——— electrical method of treating consumption has been the subject of official test at St. Luke's Hospital, static electricity being used. 'A powerful germ-killing drug is placed upon the patient's chest and, by the power of electricity, is driven through the skin, flesh and bone of the chest walls, and so into the diseased structures of the lungs.' In the near future we may have specially constructed electrical machines with the necessary apparatus to introduce medicinal substances into the tissues of the body."

This article evidently was inspired by the newspaper reports its author mentions. Several of them are before me as I write. One is the typical achievement of yellow journalism. A flaring picture of a patient spreads across a page. The static machine looms in the upper corner. A cut shows "how the germs look before the current is

applied," while a second medallion illustrates the "germs of consumption killed by gas." The seven broken columns of descriptive text bear the usual marks of "conservatism" and "devotion to medical science" that so endears these journals to progressive physicians. Let us quote a few extracts:

"DRIVING DRUGS INTO THE LUNGS TO KILL CONSUMPTION.

"At St. Luke's Hospital the ——— Treatment, Which Uses a Force Like the X-Ray, is Being Tested Before a Jury of Doctors.

"The new century may be ushered in with the positive announcement that consumption is a curable disease, and to that declaration there may be added all the weight of reliability that comes from an endorsement by St. Luke's Hospital.

"St. Luke's Hospital is probably one of the most conservative institutions in the country. No startling innovations are introduced there, neither has the hospital ever obtained notoriety from the exploitation of new and strange 'cures.'

"Any method of treatment that is tried at St. Luke's receives from that fact alone an endorsement that is priceless in scientific and medical circles. To say that at St. Luke's Hospital a certain treatment is used is to lift the matter out of the list of mere experiment."

Exactly. But listen further to the journalist:

"Nine physicians have been appointed as a committee to watch and test the results of the experiment. The Board of Health of the city of New York occupies the position of referee in the matter, for to avoid the possibility of error all the microscopic examinations that are necessary are made in duplicate.

"The ——— method of treating consumption is new (!). It is also revolutionary in a sense, for it utilizes a hitherto unsuspected force in electricity and by means of it secures for a curative agent entrance to a cavity of the body heretofore closed to medicaments. This is a new force of electricity which to the physician will be as valuable as the X-ray was to the surgeon."

A great many new (!) things happen to electricity in the course of sensational journalism and quack advertising, but the odor of Peruvian balsam seems to have drifted down the years and to exhale from this "discovery" in the editor's office that "a powerful germ-killing drug is placed upon the patient's chest and by the power of electricity *is driven through the skin, flesh and bone of the chest walls* and so *into the diseased structure of the lungs.*" Skipping now several columns of valuable journalism on the causes, ravages and generalities of consumption and keeping only in mind the engrossing extracts so far quoted, and the jury of nine physicians, we pass directly to the reporter's painstaking details of the treatment:

"The ——— method differs entirely from those which have preceded it. Professor ———, in his investigations into tuberculosis, became familiar with formaldehyde gas, but unlike other investigators, he was not deterred from using it. Certain discoveries which had been made in the realm of electricity occurred to him—he tried the experiment—the result was success and the ——— method of treating consumption by means of formaldehyde gas was established. His treatment will cure every case of consumption in the first stage, 75 per cent. in the second stage and 30 per cent. in the third, or so-called hopeless state.

"Up to that time (the time of this new discovery) electricity had never been used to aid in the administration of drugs (!!!), but experiments developed the fact that it could be so used. As a measure of precaution he used static or natural electricity rather than dynamic, because of the danger (?) to the patient from the use of the latter current."

I allow a moment for reflection on the above statements and proceed with condensed extracts from the balance of the report:

"In applying the treatment the patient is stripped to the waist and after being placed on a couch or operating table is carried near to the machine. Then a sponge filled

with formaldehyde is attached to one pole of the electric machine and placed on the sufferer's body. In some cases another sponge similarly charged with the gas is held close to the mouth of the patient and connected with the battery, while in other cases the second sponge is placed against the patient's chest. Then the electric machine is started and the static electricity flows in a steady current through the sponges and into the body of the patient, carrying the formaldehyde with it and annihilating all germs with which the gas comes in contact. The matter expectorated by the patient is examined just before the current is applied and the germs are found by the thousand alive and moving. Immediately after the operation another examination is made. *Usually all the germs discovered are dead.*" (!!!)

If space permitted, it would be a labor of love to conduct my readers through the whole report of this *new* (?) method of employing static electricity. There is much in the report that I must leave out, including the touching presentation of the "non-mercenary nature" of ——— and the appeals from the "scientists of America," which alone have brought the treatment to this country." My readers may wonder at the spectacle of St. Luke's and the jury of nine physicians, and ask how it came about. Many asked me the same question. I do not know. How slight a knowledge of static electricity (a knowledge easily obtainable in New York) would have spared the institution its present position may be judged by all who have read the rudiments of the subject. The inevitable outcome of the test of an impossible "method" is stated in the following letter:

St. Luke's Hospital, New York.

"Replying to your letter, I would say that ———'s method of treating tuberculosis by electricity was on trial in this hospital for three months, under the supervision of the Medical Board. Several months ago the Medical Board declared the results to be negative and asked permission from the Executive Committee to cease their in-

vestigations and to have the apparatus removed from the hospital. This has since been done.

"————————, Superintendent.

"*July 1, 1900.*"

A year previous to the writing of the above letter the Cleveland Journal of Medicine (June, 1899), published the following item in its "medical news," referring to the same alleged method:

"One of the most disreputable and, unfortunately, one of the most successful of tricks, was worked upon the American Medical Association at its Columbus meeting. A quack consumption cure, ————s, having been repeatedly refused a hearing before the meeting, managed to get itself placed in the newspapers in such a way that both the public and the profession have been misled into believing that it had a hearing before the association. The meanness and sordidness of those who would thus prey upon the poor victims of tuberculosis under false pretenses of scientific recognition is beyond the power of ordinary words to convey."

This curious episode in the career of a "conservative" New York hospital is said to be *still of great financial benefit* to the promoters of the "cure."

When a wet cloth or sponge is placed upon the bare skin of a patient and a breeze or spray discharge applied, the conditions are exactly opposite to the indications. Try it yourself with any wet towel laid upon the chest. The water is a better conductor than the tissues behind it, and not only is there no osmotic push of fluids from one pole to another, but the attraction is *out* of the patient and not *inward*. The law is that opposite electricities attract, and in the case of galvanic cataphoresis the two opposite poles of attraction are on the patient, and the current between them must flow *into* the tissues. In the case of the static current, however, we do not make contact with two poles, or if we do, then we either destroy the essential accumulation if the patient is on the

platform, or we use the Leyden jar current, which resembles the faradic and, like it, has no electrolytic or osmotic action. On the contrary, the insulated patient is charged with the potential of but one pole, and when this charge is attracted by an opposite electricity the "pull" of the attraction is not inward to a second contact, for there is none, but is *outward to the grounded electrode* that is held at a distance from the body.

Moreover, the wetting of the skin makes the application of the static breeze or spray a mere cool wind, with the least therapeutic action that can be imparted to it. This is not the way to treat consumption with this efficient agent. The alleged inhalation of the gas is not "cataphoresis," nor is the assumption that any of it is "driven" into the lungs, and that it there "kills the germs," any better founded than the statement that a rabbit's foot will "hoodoo evil spirits."

Owing to the widespread circulation of the advertisements of this so-called static cataphoresis, and the publicity given to the "method" (?) by the lay press, which seeks only sensation, it may be some years before we hear the last of it. Physicians constantly ask me for information on the subject, and I, therefore, have felt obliged to put the facts on record, so that students who seek them may be informed. I do not see how such a method could be honestly exploited by any one who understood the first rudiments of electro-therapeutics, for it is as transparent an error as can be imagined. Go back to your study of static sprays, and test the influence of regulated resistances on their therapeutic action, and you will need no further light on the "cataphoric" method.

245. A few tests now with the so-called *massage roller*, which is merely a modification of "frictions" when the current is employed in any other way than as a slow muscle-contractor. With the plates in rapid action, test the application on yourself before attempting it on a patient, for a novice may unwittingly make into torture

what ought to be entirely tolerable and beneficial. Test slow, medium and rapid rates of change, with the electrode up and down the spine, on the arm and over the upper surface of the thigh, all of which regions you can reach without assistance by the use of the author's electrode handler.

246. Connect first as for positive frictions, and note that the effect is the same and the conditions of treatment are the same. You might as well use the ordinary electrode in the same manner. Note also that you can only "roll" the roller. You cannot rub and turn or glide it freely in any direction you wish, as you can the ball and blunt point electrodes. It is also heavier and is flat across the area of contact, so that on certain portions of certain spines which are not flat, the electrode does not fit as well as the ball.

Note the difference between the negative and positive poles with this application, and note the various methods of controlling current-strength.

247. On the thick muscles of the thigh next test the true *massage* action set up by slow interruptions of the current by a spark-gap between the sliding poles. This calls for an entirely different method of connection. In the first instance, the poles were wide apart and the electrode was grounded. Now, put the sliding poles close together and ground only the opposite pole of the machine. Attach the electrode to the active pole and sit the patient on the platform, without any connection as yet between him and the machine. Start the current into action and hold the electrode in the left hand, so that neither you nor the patient obtains the discharge. With the right hand, next draw the pole nearest you slightly away from the other, and gradually increase the gap till the spark stops. Before you begin to treat the patient at all, test the lengths of spark-gap you get with different rates of speed and note the thrill of the current along the handler. This gives you some idea of its intensity.

Now close the poles and put the electrode on the patient's thigh. Start the current into action and slowly create a spark-gap just sufficient to let a trace of current action reach the tissues. The spark-gap is a *shunt* current-controller; in fact, a rheostat, and must be regulated on the same principle. The shorter the gap the less resistance, hence more current crosses the gap than goes through the patient. As the air space is made longer, the resistance increases, and more current is *shunted* around to the patient than is carried directly across the gap. Also note that slow interruptions imitate a slowly interrupted current of another type, and set up slow contractions, while rapid sparks simulate other rapidly interrupted currents, and set up a tetanus, or would do so on a bare surface. But you find even a small current quite "hot" if the electrode is held still, and infer that the term "roller" was given to the electrode because it must be kept *rapidly rolling.* Not so. Simply eliminate the resistance under it, and you may hold it as still as a faradic electrode, and with the same tolerance. Therefore, study the influences of resistance and the regulation of all degrees of dosage.

Note, also, that in this method you apply the electrode to the patient without a startling spark, such as you give the patient when he is directly connected with the platform and the electrode is grounded. By the massage method, regulated by the spark-gap, the patient is not connected with the platform at all until the electrode connects him by its contact. This is a useful method, and should be studied till you are master of all its possibilities. Counter-irritation is its chief value.

248. And here let me say that the close and painstaking study of the whole subject of cutaneous irritants and *counter-irritation* will be of the greatest value to the owner of a static machine. Study reflex actions. Study the principles behind therapeutic recommendations of all external remedies, and the application of the same prin-

ciples to the uses of static electricity is in most cases only a question of skilled technique. Do not study to remember treatment of diseases by any system of routine applications, but consider treatment from the standpoint of *actions to meet indications.*

In almost all cases a given therapeutic action can be produced in more than one way. There is a choice. This is often to be made for other reasons than the *general action.* In different patients of different ages, sizes, sexes and conditions, and when different parts of the body are affected by the same disease, the same effect can often be more conveniently set up by one current, or one method, than by another. In electro-therapeutics it permits many refinements of quality in current action to be able to choose the manner of producing your effects from among several methods, instead of being limited to one. With static electricity, for instance, you can set up a counter-irritant action in half a dozen ways, and vary the dosage from the slightest warmth to an intensity just short of actual vesication, and do it more quickly and with more complex and complete effects than by any drug irritant that can be named. Even the remarkable slow alterative irritant action of iodine applied for its most peculiar effects, can scarcely show any results that cannot be more efficiently procured with static electricity by the expert on parts that can be reached with this current. In some other situations we still have the efficient electrolytic actions of galvanic polarity to equal and surpass iodine and its congeners.

249. In urging the physician to study the actions of static currents and the art of producing needed effects, we must dwell for a moment on the conditions which influence effects.

Imagine a room ten feet square filled with air at the temperature of sixty degrees. What will be the effect upon the body of a person who enters it? Can you answer such a question without taking into account the re-

lated conditions? Ordinarily, the effect might be negative, but conceive that you step into the room from one of the following previous states:

1. From the exposure of a winter day, with the thermometer at zero. You would probably at once perspire and complain of warmth.

2. From the hot room of a Turkish bath, where the temperature had been 140. You would probably at once feel chilled, and request coverings; or,

3. Sit one hour in the room with thin garments on, taking no exercise; or,

4. With heavy clothing on take vigorous exercise in the same room.

Also imagine treating a half-frozen teamster to a dish of ice cream in December. In *July*, it would be one of the most grateful of remedies for the *heat*; but when the condition is "cold" the indications change. Follow this line of thought through the uses of other remedies than static electricity, and you will glean much light on the practical plainness of the indications for this agent. You rub *snow* on a frost-bitten foot to *warm* it, but a "cold bath" for the typhoid patient is 65 degrees. A *cool* bath is 85°, but imagine putting a frozen extremity into water of this *heat*. Take the manipulations of the *masseur* around an inflamed joint; what would be the effect of the same massage on normal muscles or a normal joint? Negative.

You cannot abate a fever with aconite if there is no fever in the patient. You cannot abort a malarial chill with quinine if the patient has typhoid instead of malaria, and you would not expect immobilization to strengthen and repair a normal joint.

These things are so obvious and so elementary in medicine that were it not for my experience in teaching physicians that the same principles direct the prescription of static electricity I should deem it superfluous to mention them. But it is with the greatest difficulty that

these rational rudiments of prescribing the static current percolate through the general profession. Students ask what application is "sedative," or what application is "tonic," or "stimulating," without any recognition of the fact that all therapeutic effects rest on the deviation from normal presented by the tissues.

250. A few years' experience will teach the operator much more on this point than he can grasp from reading any verbal statements about it. The following case affords an extreme illustration of the idea:

L ———, age 65, right hemiplegia four years ago, gangrene of right foot a year later, with amputation of big toe; right-sided sensory paralysis; six months ago cataract operation, which failed to restore sight. Opthalmoscope suggested and urinary examination showed advanced Bright's disease. Left side is becoming anæsthetic. Poor sleep for two years; for past eight months has had to get up from six to ten times every night, walk up and down, and rub leg muscles, to relieve "fidgets." Tongue heavily coated, face puffy and saffron. Cannot balance without cane, or walk without aid. Two members of family accompany him for safety. Very "nervous."

"Sedation" was deemed indicated by several physicians present, and the application was so *sedative* that he broke into a smile as he declared that it "felt good." At next visit reported that he had slept all night without rising once, for the first time in two years. That he felt refreshed, and could walk better. On third visit reports: "I am not the same man at all. Slept from 9 o'clock P. M. till morning without waking; have scarcely any nervous state left; I now keep warm; previously my legs were always cold; I feel natural, more vigor, good appetite; would like to come alone; can walk with much more confidence, and do a short distance without a cane."

At the next visit he reported that he had no more muscular twitchings, and that sensation had reurned to

nearly normal. He had no drug remedies from me for the reason that he was sent as a hopeless case to see if static electricity would do him any good after drugs had given negative results.

In citing the case so far, the point I wish to make is the apparent contradiction between the term "sedation" and the method I employed. Stating in advance to the class present that I would produce a sedative effect, they were surprised by the *vigorous assault* immediately made on the tissues, and they expected to see the man wince; but he only smiled and said: "It feels good."

Theoretically, the positive spray would be "sedative," and would be the inevitable choice of the beginner, but when we take into account the nature of the pathology, we see that the true indications call for something very different from any spray, and he *got what he needed*, as the results proved.

It is probable that a larger percentage of static applications are not so effective as they should be for the reason that operators omit to follow closely the usual principles of all rational medical prescribing and fail to take advantage of the great flexibility of this remedial agent. Do not forget that the secondary action of an intense irritant may be sedative, tonic, alterative, stimulating, nutritional, and much more,—according to the state of the tissues to which it is applied. Do not forget that static electricity is a means of producing all grades and doses of irritation and counter-irritation. In this respect, it is without an equal in therapeutics.

251. I assume that the reader will find sufficient material in the chapters on faradic and sinusoidal currents to enable him to test the *Leyden jar methods*, which are very similar. There are certain features of technique that must be observed with Leyden jar currents, but the physician will find them out as he makes the tests. Having done a large amount of experimental and clinical work with this current, my uses of it have settled down

to a few applications of a special character. I, therefore, pass to the consideration of the direct interrupted static current originated by me some years ago.

252. In this system of employing static electricity, the patient is connected directly *to one electrode attached to one prime conductor*, the opposite pole is grounded as usual, and the insulating platform acts as the condenser. The *rate of interruption* is regulated by a spark-gap in the external circuit, and other elements of dosage are managed by this shunt rheostat, as usual. It is a flexible and valuable system, capable of both *general* and *local* administration, and of late has been strongly advocated by other writers than its originator. To become familiar with its uses make the following series of tests:

Place the sliding poles in contact to start the current at zero. Ground the positive pole. Connect one end of the author's "sparker" to the negative pole, grasp it with the right hand in the most convenient part of the insulating handle, and apply the large ball to the side of the neck, which is a suitable area for tests. Before handing this electrode to a patient, always warm the ball that is to be applied to the tissues.

253. With a gradually increasing dosage test the same differences of *pressure* that were so important in our chapter on faradic currents. Note that you have a far more flexible control of the *rate of interruption* than any faradic vibrator can provide. Test the effect of each minute lengthening of the spark-gap. Repeat the test at all rates of speed of the plates, and note how voltage and volume rise and fall in proportion as speed produces current and your "shunt rheostat" spark-gap lets the current divert in part to the tissues. To demonstrate the exquisite fineness of skilled dose regulation apply the smallest size olive electrode, connected in the same way to the eyelid over the external rectus muscle. With a proper control of the shunt the action upon the lid is as smooth and delicate as a fine coil current. But this will

not be so if the operator neglects the first principle of smooth current action—to wit, a perfectly polished surface on the shunt balls.

254. Before going farther with treatment tests, let us devote a moment to appreciating the importance of "polish" in relation to static electricity. Run a series of heavy sparks between the poles long enough to oxidize the surface. Let them tarnish over night. Then test the current with the sparker on any uncovered part of the tissues. Note that the smallest stream of sparks breaks rough and ragged through the resisting film of tarnish. *Look* at the stream and *listen* to it. Note its color, character and sound. As you draw the poles apart watch the obstructing action of the film. See how it makes the discharge sputter to break through it, and splits the spark into ragged and secondary discharges. Note that the current *feels* just as it *sounds*, and illustrates again the guidance of the trained ear to the quality of the dose.

Now take your polishing chamois, that is as essential a part of your equipment as the spark electrode, and brighten the ball surfaces till they shine like mirrors. Repeat the tests of *current quality*, and note the even and free stream that now pours readily from pole to pole. It sounds as smooth as it looks, and feels as regular and even as it sounds. All jerkiness is removed from the dosage, and the tissues accept the current now with a very different satisfaction. Never forget that all surfaces from which discharges should glide smoothly must be "lubricated." The way to lubricate a static electrode is to polish it.

Not long ago, one of my students wished to alter one of his brass point electrodes so as to make it give a special spray such as I demonstrated. Static electrodes do not all come from the workman's hands in proper shape to use, and all of my apparatus bears more or less evidence of my personal attentions. After following my instruc-

tions about altering the point, he reported that it would not give a spray at all, and all he could get from it was sparks. I asked him to bring the electrode to the next clinic, and he did so. In his presence I completed his imperfect polish of the point, handed it to him for test, and to his surprise it now gave as superb a spray as could be desired. He remarked that, "unless witnessed, no one could believe so great a difference in a static spray depended on the condition of the point." He thought he had it beautifully polished, but it lacked the essential "lubrication" of the jeweler's rouge.

255. Now take up the tests we began a moment ago.

Place a small square table on the platform in front of you and roll up the sleeves to the shoulder. With the current at zero, grasp the large ball of the sparker electrode between the tips of three fingers and thumb. As the current is slowly advanced to a medium dosage, lift first one tip and then another, and test the relation of *area of contact* to current *density*. Reverse the test and note that a current of full tolerance with the electrode held with *one* finger is not felt at all when *three* fingers increase the contact and divide the amount each one receives.

Now slowly roll the ball of the electrode down the fingers to the palm, and vary the dosage so as to test all the degrees of action on different muscles. Around the wrist there is much room for tests of tolerance and action. Practice on both the extensor and flexor surfaces of the forearms a *slow rolling* of the electrode, a *stabile* action on different parts, a *slow* and *rapid* labile action, with *short* and *long* sweeps, with *light* and with *deep pressure*, and with all *rates of change* in the *interruption*. You will find that my system of thus using the static current is exceedingly flexible, and parallels the actions of Leyden jar currents with the following advantages when these are desired by the physician:

a. But one electrode contact is required.

b. The patient is benefitted by a *general static charge* at the same time he is receiving his *local treatment*, while Leyden jar current action is local only.

c. Some applications can be made with this method that cannot be easily accomplished by a technique, which requires two electrodes.

d. Certain applications are possible without exposure.

256. Next, with the electrode on the arm, practice the "swelling" action, that can be set up by drawing the poles just beyond full dosage and quickly returning them to gentle action. Some experience is required to employ the useful swelling method on patients, and this can only be obtained by practice on yourself.

With the current at a medium dosage for *muscular contractions*, next place the ball of the sparker in turn on each motor point of the arm and neck. No other form of application can so beautifully bring out the local actions of each muscle, for there is no second electrode to influence the results.

257. If you have noted sensations as you have made these tests, you have observed the important bearing of *resistance* in this, as in all other uses of electric currents. If you know how to control resistance there is very little that you cannot do with respect to dose regulation. Suppose that on the back of your arm there is considerable growth of coarse hair. This condition would not exist in the case of a boy or a female patient, and as the conditions differ, the dosage differs until you *make the conditions equal.* A volume and voltage with the sparker that would comfortably contract the muscles of a woman's arm without irritation would bite so intensely on your hairy arm that you would at first think the current was to blame. Not at all. Simply cut out the superficial resistance of non-conducting hairs, and the dosage can be comfortably developed on yourself.

How can you do this? In several ways, all on the same principle, which should be already familiar to every

student of my writings. For instance, soap and water make good conductors. I also often lubricate the hairs with a little liquid alboline, which enables the electrode to glide over them without friction. All the refinements of technique that pertain to the uses of galvanic and faradic currents come into play in the local applications of my interrupted static current.

258. Now take a set of sponge-covered pad electrodes of different sizes and test the actions with small and large. You soon arrive at the conclusion that too large an area of contact destroys the efficiency of current density and requires so long a spark-gap that *rapidity* and *smoothness* are sacrificed. Therefore, most of the work of this current follows the faradic rule of small electrodes. Cover a larger area of affected tissues by labile *technique* with the electrode, rather than by selecting a larger electrode and a stabile application.

259. Next, wind a fine chain around one finger and test the exquisite high-tension tetanus that is set up and controlled in dosage as precisely as the finest sinusoidal current. Wind the chain several times around the wrist, the middle of the forearm and the biceps region of the arm, each in turn, and make the same tests of current action with various rates of change and all degrees of dosage. Also, test the effect of placing the muscle masses in altered relations with each other. Flexion, extension and rotation all modify the direct localization of action under the chain contact. Study these modifications.

260. Contact upon or around joints or irregular parts may also be made with tin-foil, which is easily pressed to the shape of any surface. From the foil a chain or conducting wire is carried to the pole of the machine in the usual manner. In looking over some old papers recently, I found a written memorandum of my using tin-foil for this purpose in June, 1893.

261. Now, again wind the chain around the upper arm

and vary the test from rapid to slow interruptions. Pull the poles wide apart, and with the grounded ball electrode make slow single sparks on the head of the platform rod, or on any convenient part of the prime conductor. Test one spark per second, and up to five per second. With the contact acting on the insertion of the deltoid, note that the arm is almost automatically maintained above the head without effort of the patient if the spark rate is fast enough to hold up the muscles.

To modify the current-strength I not only regulate the speed of the plates, but vary the size of the interrupting spark. Use the points as well as the ball for this purpose and note the great flexibility of this part of your dose regulation. The size of the connecting wire or chain also affects the dosage.

262. Now test the water-bath contact described in my "Manual of Static Electricity in X-Ray and Therapeutic Uses." Test it with both slow and rapid rates of interruption, and with all positions of the tissues. This technique of localizing the direct static interrupted current came into prominence in 1894 in connection with my treatment of writers' cramp and telegraphers' paralysis. I may here say for the benefit of physicians who ask if there is another form than mine of *static interrupted current*, that it is only possible to condense this type of electricity for medical use in *two* ways. One is by the condensation of Leyden jars and the other is by the insulating platform. There is no other way of *accumulating* enough volume of current to have therapeutic action. The Leyden jar output is interrupted by the spark-gap, while a circuit is made through the patient by *two electrodes*. The *system* of interrupting the current *direct from the pole to the platform*, originated and developed by me, *is the only other possible form of a static interrupted current*. All tests herein suggested, and many others, are but *localized* applications of the *general* system of "potential alternation," long identified with my name.

Any static application which places the patient on the insulating platform, and connects him by any kind of single electrode or conductor to one pole while the other is grounded, and the current is interrupted, either by a spark-gap between the sliding poles, or between a grounded electrode and any part of the patient's connection with the machine so as to discharge and recharge him in a series of *makes* and *breaks* at any rate, and whether general or local in its action, is the system originated by me, and the only other interrupted static application that is possible employs the Leyden jars.

263. Now test the current on the male perineum, both by rapid and by slow interruptions. The location of the ball of the electrode can be shifted during tests from the anal orifice to the erector muscles of the penis, and a variety of useful actions demonstrated. Secretion, circulation, nutrition, muscle tonicity, nerve energy, can all be powerfully influenced by the use of this technique after you learn how to manage it.

Study, also, its limitations so that you will not attempt to make it a "cure-all" without reason.

264. In using my sparker electrode test the uses of the small end also, and note how remarkably it will enable you to reach deep tissues and relieve pain between small joints. I, last spring, had a case of pain in the elbow, deep in the groove of the olecranon. Fifteen years ago the patient fell in mountain-climbing, and struck on his "crazy bone," fracturing the tip. Since that time he had been troubled with daily pains, worse on the approach of the storms, and causing him a great deal of annoyance. He stated that he had several times had it treated with electricity, but always with a "sponge-electrode contact," which never seemed to reach the seat of pain. The small ball of my sparker reached it with complete relief in one seance. He has had no return of the neuralgia since. In cases of sprain of wrist or finger

joints, the deep contact I can thus make has often served me well.

There are some shadings of my technique and some details of current control that can hardly be put into words, but must be personally demonstrated to be understood. There are also times when the beginner would fail from timidity and the complaint of the patient, from causes that skill would eliminate. I know no other way to do here than to leave the working out of your own skill to time and careful study.

265. One of the phenomenal actions of this current with my sparker is its quick sedation in cases of certain local traumatisms, sprains, congestions and neuritis. But in these cases you will note that the intense "pain" (?) of the *onset* of even a mild dosage is not the pain of the *current*, but is the *latent pain in the tissues*, which the current develops as it searches out the exact seat of the trouble. The search for these "sore spots" is, therefore, my first concern in such a case, and when I demonstrate to the patient by placing the electrode on a normal spot that he does not feel the current at all, he is often surprised but always receptive of the proof that it is his *lesion* that hurts and not the current. In a moment he is also gratified to observe that the pain has disappeared. In many cases of these little local states, especially affecting the small joints, and tissues of some part of the arm, I have tried the period required for complete relief and have found it to vary from a few seconds to three minutes, the latter period being a rare necessity.

I now ask you to test both on yourself and on a few selected patients one of the most important of the local applications of the author's interrupted static current.

266. Close the sliding poles to start the current at zero. Ground the negative pole. To its hard rubber base screw the smallest of the author's set of rectal electrodes and connect the handle to the positive pole of the machine. Place a folded crash towel on the seat of the plat-

form chair and place the electrode in the center with the bulb upright. Always warm and lubricate the bulb before making the connections.

A male patient now drops his trousers, or a female simply diverts her skirts, and, supporting the body with the left hand on the edge of the chair and assisting the electrode with the right, sits upon the bulb and passes it within the sphincter. No exposure whatever need be made, and no handling of the parts is required of the physician. Now draw the poles apart till the current is first felt by the patient. This will not occur with a short spark-gap, as *the tolerance of the rectal tissues to proper electric currents is greater than any external muscles of the body.* The rectum should be empty, as a matter of course.

Test the action of all degrees of dosage from the first sensation to a firm contracting grasp on the muscle fibres. Your *shunt rheostat* spark-gap will require the resistance of four, six, or even eight inches of air to force sufficient current for the latter effects around the circuit to the tissues, and not only will tolerance be perfect with this dosage but pain will be *relieved* if it exists, and *tenderness and soreness will be removed.* Test rapid and slow rates of change, the "swelling" method, and the usual variations. An important point to observe is the effective tonic *general* treatment that accompanies this *local* potential alternation. Note the long oscillations of the patient's hair and the evidences of general as well as local action. In my first report of this method in 1893 I called attention to the oscillations of the hair as a means of recognizing the quality and extent of the actions set up in the tissues, and they still guide me to an exact understanding of the dose and its correct regulation.

267. Now change the bulb for one size larger and repeat the principle tests. Do the same with every size of the entire set and then consider their therapeutic utility. Note that they *combine* the action of mechanical dilators

with the actions of electric currents. If you will read the chapter on the physiological actions of the faradic current in my book on "The Treatment of Diseases by Electrical Currents" you will learn the valuable relation of high-potential, high frequency current actions to many states of the rectal tissues, although the *common* faradic battery has no uses in this field. The philosophy of mechanical dilatation is familiar to you. Surgical instrument houses making rectal dilators assert the following claims: "They are indispensable to patients with any form of chronic or rectal disease, and for treatment after operations. Their use relaxes the sphincter, stimulates the sympathetic nervous system, equalizes the circulation and in this way cures piles, constipation, fissure, etc., and relieves almost all forms of chronic disease."

But the effects of mere *dilatation* are very inferior to the *combined actions* of the two remedies, of which the greatest is electricity when it is skillfully used. The extent to which rectal practitioners could supplement their other measures by the above method would surprise the majority of them as much as an ether operation would surprise Hippocrates if he witnessed a clinic of to-day. In another section I have referred to the gratifying results and did space permit could cite many instances from my experience.

Contrast, however, the demonstrations I have made to students (and can repeat as certainly as a cautery can scar) with unenlightened and random opinions on the subject. I have before me now a published paper read to a clinical society in November, 1899. The author "was for a number of years professor of rectal diseases in the ——— Medical College, and enjoyed a large practice in this department of surgery. He is the author of a very popular text-book on rectal diseases, several editions having been exhausted. Dr. ——— is now occupying a chair in ——— Medical School."

This published biography vouches for the standing of

Dr. ———, but let us see how his *own words* vouch for his knowledge of facts. He says:

"I would not be disposed to use electricity in the rectum because of the great senitiveness of this part." (!)

It is stated that probably nine-tenths of the cases coming to the physician with pain in the rectum the pain can be traced to one of three causes: An inflamed pile, an ulcer, or a blind internal fistula. Rectal neuralgia is considered rare, but cases occur. In all these deviations from normal and in other functional distresses in the rectum that are hard to characterize in terms of diagnosis, the electrical sedation, alteration, stimulation, or other therapeutic actions which the expert commands, will be found wonderfully *palliative* when radical surgery is needed and *curative* in the majority of other cases. In the absence of pus which must first be evacuated there is scarcely a rectal pain that some skilled application or some electric current is not competent to relieve, even the pain of cancer. A couple of years ago the late Dr. Skene, one of the foremost of American gyneologists, sent me a young woman suffering with an obstinate pain in the lower spine. Her history of medical and surgical treatment for nine preceding years was one of the most remarkable I ever met, not however all relating to the spinal pain. A counter-irritant static application on the lower spine gave her complete relief for twelve hours after each treatment and this was "the first relief she had been able to obtain." It is one of the rules in static therapeutics that when a proper treatment gives prompt relief and raises hope of cure, yet does not advance beyond primary palliation, that there is an active exciting cause of the pain which is not reached by the current and which must be attacked by some other means. I, therefore, reported my opinion to Dr. Skene and the patient was placed in his private hospital and anæsthetized. High up the rectum, nearly as far as an examination could reach, was an inflamed patch of membrane which accounted for

the pain. That an external static spray could have given her the degree of relief she had reported was astonishing in view of the situation of the causative lesion. Such a case would not be "cured" by the rectal method I am here presenting, but by it we can tone up relaxed fibres of blood vessels, muscles and nerves, combat venous stasis, allay irritation, improve local nutrition, restore power to an impaired sphincter, relieve anal itching, heal a fissure or any lesion that is the product of morbid nutrition and that can be reached by the electrode for direct action by the current, and if any of these conditions are attended by pain or tenderness the pain and soreness will be abolished. Much of the same work can be done by other methods, but by none other does a single electrode suffice, and none other so completely humors the average patient's dread of rectal exposure.

268. In all the foregoing tests of *localized* potential alternation you may compare the actions of both poles, testing first the negative and next the positive. You will find that the higher voltage of the positive pole affords a given dosage of current-strength with less spark-gap than the lower E. M. F. of the negative pole. There is a sharper bite to it also on tissues that are abraded or covered with an adventitious resistance in any degree. The regulation of dose and resistance controls this and the therapeutic actions of both poles are what you make them by your technique. There is no contrast of polar action, as in the case of galvanic electrolysis.

One point to mention is that the capacity of the conductor between the electrode and the machine governs the volume of current to quite an extent and this affords an additional means of adjusting *current-strength*. The variety of electrodes you can employ with this interrupted current is scarcely limited by anything but your own convenience and the necessities of good contact. This sufficiently directs the study of local applications of

my system of using the insulating platform as a "condenser" instead of the Leyden jars.

269. We will now take up the *general tonic method*, which I christened "potential alternation" in 1893 for want of a better name. It does, in fact, alternate the potential or electrical charge of the patient between zero and the highest current, but the scientific accuracy of the name has never made it convenient and satisfactory.

There are many ways of administering P. A. wrong, and but one way of doing it right. To appreciate this and to develop skill in the proper method, make the following series of tests:

Ground one pole of the machine, put the prime conductors in short-circuit, sit on the platform with the connecting rod in your hands (both hands) and let it rest on the ungrounded pole, while an assistant gradually increases the spark-gap from zero up to tolerance. Reverse the polarity and repeat the same. Compare the efficiency of one pole with the other and remember the apparent "current-strength" of this method.

Now let the rod rest on the wooden surface of the platform and make one test of the feeble current that reaches the patient when so poor a contact is made.

Next place the rod on the platform and connect it with the chain from the brass tray that I am in the habit of using. Ground the opposite pole and draw the poles wide apart. Stand the grounded ball electrode on the standard, so that it is near the small ball at the top of the platform rod and see that both balls are brightly polished. Now remove your shoes and start the plates into rapid action as you step to the platform and sit down in the usual manner for treatment. Take with you my insulating hook and with your feet both flat on the tray draw the head of the rod away from the electrode ball till you reach the maximum spark-gap. Note that the current in no way disturbs the feet. Try different lengths of spark and then test the reverse polarity. Note how the cur-

rent-strength compares with the interruptions between the sliding poles, and how the positive and negative energies compare with each other. By this time you have learned why I always use the positive pole for the connection with the patient.

Now put on your shoes and regulate a long spark-gap before stepping to the platform. Sit on the side of the chair, grasp the seat with the hands and lift both feet at once and swing round to position and drop feet to the tray. What happens must be felt to be appreciated. No object-lesson is more benefit to the practitioner. It teaches that you must eliminate *all resistance* to protect your patient's feet or you must *insulate* them by an excess of resistance so that the current cannot drive through it in the form of intolerable sparks. This insulation I secure with non-conducting paper. How much paper is required? That depends on the potential of your current, and is ascertained by test.

Take some large trade journal that will leave a margin all round the feet and lay one copy on the tray. Begin the current at zero and note how long a spark-gap it will protect you from. Then lay a second copy on top of the first, and add copies till the strongest current you can produce will make but a gentle thrill in the soles of the feet. Then you have enough. Lift one foot during a test of the maximum current and learn again how it doubles the density to divide the area of contact.

270. The next thing to learn is how to develop efficient therapeutic dosage, for thus far you have been testing merely the rudiments of the method.

When the spark discharges the entire current from the patient and the positive pole of the machine the patient is recharged in the brief interval before the passage of the next spark. To increase the energy of this *recharge* which constitutes the essential portion of the treatment I exert a powerful "pull" upon the *ingoing current*. To comprehend the logic of this stand in front of a stout man

and push as hard as you can with one hand upon his chest. Now have some one behind the man take hold of your other hand and pull on you as hard as he can. By the reinforcement of his "pull" your "push" is about doubled in E. M. F. The same rule applies to electricity. Swing out over your head the rod of the head-breeze electrode, which is one of the indispensable necessities of every static machine regardless of who made it. With my insulating hand you can reach up and shift it to all distances from your head and note the effects of all ranges. Note also that electricity will follow the path of least resistance, and if the attraction is stronger between your head and the current than it is between the spark-electrode and the current the spark will stop and a simple electrification with head breeze will result. Learn from experience the distance you should adjust between the head and the grounded attracting electrode, and note that this is not a routine, but is varied by conditions just as all other factors of dose regulation vary.

271. Now let us study the exact regulation of the dose, for on this the therapeutic effects depend. A dozen men may treat patients in what they suppose is the same method and not one of them may know he is losing 20, 40, or 60 per cent. of the therapeutic action through faulty dose regulation. My method has a *standardized dose* when employed for tonic effects and will fail in great part if not correctly regulated. Physicians coming to me for instruction have often claimed to have been using *P. A.* from study of my earlier book and on demonstrating the proper dosage to them they have been suprised that so great a difference could exist in so simple a technique.

With all connections properly made for treatment, begin with a spark-gap of a half-inch. Here we have a beautiful means of testing the once agitated question of high frequency rates of interruption and you will note that a rapid speed of the plates breaks the continuity of current action so frequently that but little action reaches

the patient. Lengthen the spark to an inch. With a slow speed of interruption you are now more conscious of some action taking place, but with a high frequency spark you feel very little.

In the same way develop all the contrasts of action with all lengths of spark and all speeds until the maximum of *regularity* is reached. When the discharge begins to break unevenly push back the electrode to the former limit. In making these tests you have noted which spark-length and which rate of interruption appeared to make the greatest impression upon the system. At all times thereafter it is at once easy to adjust the same dose for use upon a patient.

272. Many have asked me by letter what length of spark they should employ. It will differ with the *current-efficiency* of the machine, and in any one machine will vary according to the conditions which control all phases of static electricity. Have in mind the effect you want to produce and then adjust the current so as to produce it. That is my rule in all electro-therapeutics. I can demonstrate with potential alternation effects which are of the proper kind and only lack *equality of E. M. F.* with spark-gaps from four to ten inches in length. I have often measured a ten-inch spark from the grounded electrode to the platform rod for the benefit of students, although my *ultra*-conservative book on static electricity, written in February, 1897, refers to little more than half this length.

But it is not alone the length of sparks which adjusts the dose. The discharge from the electrode must be thick, regular and of the correct frequency. The *sound* is again the note of *quality*, and the *frequency* is manifest to the eye as well as to the ear. The loose hairs of the patient are your guide as you stand at the rheostat to start the treatment, but you cannot see your own hair and will substitute a few strands of string. Tie together at one end six strands two feet long of white cotton cord,

such as is used to bind tampons. Hold them by the knot a foot above the knee which is farthest from the machine and let the free ends fall as they will. Start the current into action and when the strands stand out at tangents with evident strain and tension as if repelled by a high E. M. F. the *first half* of the dosage is correct. When the *rate of interruption* is such as to produce vigorous, even, coarse oscillations of the strands the *effective therapeutic action* will be set up and the patient will derive the desired benefit from the dosage.

A slow, jerky rate will tend to annoy a nervous person and too fast a frequency will not *shunt* sufficient current to the patient to establish the necessary action. The one drawback to the method is the noise of the spark, but only a bystander observes this.

273. For the most part the sedative-tonic and refreshing action of this technique lulls into rest the whole system of the patient so that the sense of lapse of time is dulled and the effect of a long nap results. No notice is taken of the sound by the patient's ear when the spark maintains its proper *rhythm*, but rather it is an aid to the sedation of all the senses that is so markedly the action of this method. Not only have insomnia cases slept better after it, but over and over again patients have fallen asleep in the platform chair amid the bombardment of the longest spark. I have seen a young woman fall sound asleep within two minutes after beginning treatment the first time she had ever seen a static machine, and sleep profoundly till awakened at the close of the seance. She was one of the typical "nervous" women who are so often told by strangely misinformed physicians that they are "too nervous already," and electricity will "do them more harm than good."

All such cases become my most gratified patients and learn to wonder at the curiously mistaken advice first given them. I do not doubt that my method is often employed without a skilled adjustment of the dose, but even

so, it will do no harm to any nervous system which is simply "nervous." To be contra-indicated the patient must present the specific conditions which pronounce against the mechanical interruptions, and these are few. In other cases which do not require this form of treatment the method will be negative in results, but not injurious. In disturbances of the cerebral circulation similar to those produced by large doses of belladonna the noise and vibration is disagreeable, and as the patient requires other measures, I omit what is not directly indicated in favor of the definite indications. The use of any method as a routime is to be deprecated, and while stating that *potential alternation* is an admirable tonic measure I do not expect it to be indiscriminately employed. Each year that I have used it my appreciation of its merits has grown. The tests of nearly a full decade have confirmed all I first wrote of it and have added to the score.

274. When I wrote my "Manual of Static Electricity in X-Ray and Therapeutic Uses" a number of physicians had reported to me that they could not understand and copy the technique from my description. As the book was designed for beginners, it was deemed useless to insert any but the most simple and elementary methods, and I, therefore, omitted all but reference to the general method of potential alternation. My first article had then been in print four years and not only published in several medicals journals, but was incorporated in my pamphlet entitled "Practical Chapters on Static Electricity," of which four editions, numbering 12,000 copies, have been printed since 1895. For the benefit of those who have not read my static book, I republish here the extracts taken from my articles. These extracts and the tests directed in this chapter will bring the reader up to date save as respects the illuminating and indescribable details of an ocular demonstration by the author.

"It now remains to discuss *potential alternation*, the author's method of *interrupting the ordinary static current.* A

description of this method was first published in the Times and Register, September 9, 1893, under the title of "A New Static Interrupted Current; a New System of Therapeutic Administration of Static Electricity Based upon the Principle of Potential Alternation."

From this article the following extracts may be quoted:

"I have for some time employed with satisfaction to my patients and myself a new method of applying static electricity, of which I have seen no account hitherto published. It is my purpose to lay before the profession the results obtained by this method.

"In the *general tonic* method which I shall now describe no change is made in the adjustment of the machine or in the patient's clothing. The patient is seated upon the platform, and after being charged in the usual manner, his potential is suddenly reduced to zero by the approximation of an interrupter to the conducting rod. A succession of alternations between a high and zero potential may now be maintained as rapidly or slowly as desired.

"The interruptions may be regulated at will from one in any number of seconds to any number per second, and by fixing the interrupter on a standard the application becomes automatic and does not require the operator's constant attention.

"In my hands variations of this method serve me as an agreeable substitute for the static spark. Remarkable as it appears, the more or less disagreeable and often painful, and to some intolerable, spark has been for more than a hundred years the main therapeutic reliance in the static treatment. Many a patient has been lost by the incautious use of sparks on a first visit. It was the desire to avoid the disagreeable features of the spark application that led me to develop my new system of *interrupted static current.* It is painless, simple and effective. As a general nutritional treatment it leaves little to be desired that could be obtained by sparks. By the application of conductors I *localize* it to any part as large or

small as I wish, and by local methods it resembles high potential faradization. By slowly repeated powerful interruptions the effect is made exceedingly stimulating, while the more rapid the interruptions the finer and more sedative the effect. It can also be made to produce a most exquisite, yet easily borne, counter-irritation. I find it to answer well for certain general and many of the special and local indications for sparks, while it seems to lack little of their peculiar power to rapidly remove localized pains deep-seated in fibrous tissue. I have tested it in many ways, and the possibilities of its successful application grow apace with experience and ingenuity in using it. It does not altogether enable me to avoid the use of sparks; but a comfortable method which will produce identical results, in many of the cases to which the spark is applied, cannot fail to be a source of relief and gratification to both physician and patient. Whatever of therapeutic value is imparted to galvanic and faradic currents by "interruption" must also be imparted to the static current; and the speed of the interruption of the static current can, by my method, be made to cover a greater range than any faradic vibrator yet invented. When administered merely for its general nutritional effect, it is exceedingly suggestive to note the visible oscillations of the patient's hair, to feel the vibratory commotion in the surrounding atmosphere, and to consider the molecular disturbance and alteration of nutrition which must be going on in every part of the electrified body, since the potential inside a conductor has the same value as at any point on the surface.

"And this alterative commotion among the tissue cells, quickening the protoplasmic activity, is carried on so mildly that the patient is conscious only of the gentle breeze. As regards local applications to give muscles work and stimulate contractions, I have found my method of practical service, and this too on certain days when, from atmospheric conditions, no spark could be

drawn through the patient's clothing. Patients coming in with damp garments on rainy days have been successfully treated when, had I depended on sparks, I should have been left without resource. In order to estimate the relative value of an interrupted current and vibrating potential as a therapeutic application of static electricity, we have only to compare it with the three classical methods in general use—insulation, breeze and sparks—and with the so-called induced current. As to insulation, my method incorporates it, but attacks its constant potential by means of the interrupter and imparts to it a succession of stimuli which must inevitably quicken functional activity. Sufficient comparison with sparks has already been made. It nearly approximates the local action of the Leyden jar current, but adds to it the general tonic action of an interrupted electrification.

"The experience of a century has given us no other general method. It is evident, therefore, from a mere glance at the extremely limited variety of static applications and the limitations of each, that a new method of practical simplicity and extensive therapeutic range is a desirable contribution to static treatment. It can be applied to the whole or any part of the body, and employs electrodes as simple as those in common use. A careful review of such records as have been available does not disclose any reference to any similar system of applying static electricity, and it may be properly claimed that this method is original with me." (1893.)

"While a number of ingenious devices might be contrived to employ in the use of this method, it will usually be sufficient to utilize the ball, point and roller electrodes. These, with the rod, a chain, a foot plate and a standard will enable the operator to obtain about all the effects he may desire. The ball electrode is used as an interrupter, drawing sparks from the prime conductor instead of from the patient. If the roller is attached by a chain to the machine, it may be applied by the operator to any

or all muscles in turn, and rapid or slow, mild or very powerful, but painless contractions may be set up. If the patient's feet are placed on a metal plate or in a foot-bath and metallic contact made with the machine, a negative breeze electrode placed at a proper distance above the head, while the ball electrode, grounded and fixed on the standard, is adjusted so as to draw a succession of long sparks from the positive prime conductor, a tonic and alterative effect upon circulation and nutrition will be obtained that is exceedingly beneficial in cases of disturbed equilibrium of the vital functions. As a means of giving exercise to the arms there is no other method superior to potential alternation. Simply wind the chain around the forearm (bare) or apply a local electrode and proceed to interrupt the current. Every muscle will be brought into play, more or less, according to situation of the contact. If held in the hand, or if the hand is immersed in a bath, an effect extending up the entire arm may be produced. I have noted in cases I have exercised in this manner that the muscles not only become firm and play under the skin with remarkable facility, but that the skin itself becomes tanned as if from exposure to outdoor sun and air. I have never seen this effect produced by direct sparks upon the person, but have witnessed it repeatedly in cases treated by potential alternation. The pallor of persons confined to the house by protracted illness is thus removed very rapidly and replaced by a healthy color, even though they continue to remain indoors.

"In static applications there are but two chief forms of the kinetic energy to consider. One is the direct flow along the prime conductors; the other is the flow through Leyden jar condensers. It will be noted that my system *involves all methods of interrupting the direct static current.* In my method the manner of the interruption is immaterial as relates to the principle of action, and is important only as it modifies the effect. For instance, the in-

terruption is made in local uses with the sliding poles the same as is now done in the case of Leyden jar currents, but I do not recommend this manner in *general* electrification for the reason that the control of the rate of interruption as well as of the dose is far less satisfactory than when the electrode is used, as I have preferably described. Moreover, as demonstrations of the high potential energy of either interrupted static current a perceptible effect may be obtained from the application of a single electrode whether the second pole is grounded or included in the circuit or not; but to obtain full therapeutic usefulness it will be well to adhere closely to the methods recognized as most effective in actual practice." —(*March, 1895.*)

Note.—(*January 4, 1900.*)—"The Monell 'INTERRUPTED STATIC CURRENT" employed the patient on the insulating platform connected by a local electrode or general contact with a single pole of the static machine, while the opposite pole is grounded, constitutes a therapeutic resource as distinctive in type, as various in methods of application, and about as valuable as any other single intermittent current, whether derived from faradic coils, a sinusoidal apparatus or from the static machine itself through Leyden jar condensers. Since originally described by me it has been in use now nearly seven years. Others have employed it from my writings and accord it high praise. Its *local* uses cover most of the ordinary uses of coil currents, with the advantage of the systematic effects of the electrification of the entire body. Its *general* application has for years constituted my chief tonic method in private practice. Its local applications coincide with the indications for Leyden jar currents, but there is this difference between these two kinetic forms of interrupted static electricity; in the case of Leyden jar currents the *accumulation* takes place in the jars, and the course of the current in the uninsulated patient is the local path between two electrodes; in the system of interrupted static current originated and described by me in 1893, the accumulation, without which no treatment of patients with static electricity is possible, takes place

as usual on the insulating platform, and the whole body of the patient benefits by the complete "charge" or electrification which the method involves. It thus adds a *general* effect to every *local* effect, something which no other kind of intermittent current locally applied accomplishes for the patient. Prior to my publication of September 9, 1893, in the Medical Times and Register, I had employed this interrupted direct static current locally in sprains, writer's cramp, neuritis, circumscribed burns, paralysis, rheumatism, arthritis of small joints, pain of various kinds, and numerous other conditions. I had used the several static electrodes, tin foil, pliable sheet tin, sponge-covered faradic electrodes, chain, water in localizing vessels, etc., as means of contact for the parts treated, connecting the same to either positive or negative prime conductor with the patient insulated and the opposite pole grounded. Local applications require exposing the surface of the skin the same as Leyden jar and coil currents. Having subjected the current to every practical clinical test during about seven years, it is gratifying to find its value being recognized by others who have adopted its use from my teachings and writings. The name "potential alternation," which I first employed to express the actual rise and fall of the patient's electric potential has become widely identified with my *general tonic* use of this static interrupted current, but many have overlooked the important *local* uses of the same current referred to in my original article. I, therefore, again direct attention to "A New Static Interrupted Current; a New System of Therapeutic Administration of Static Electricity," with special reference to its LOCAL applications, which may be made of great utility in a considerable number of cases. It is easily employed. My early estimate of its value has been confirmed by the testimony of others. It is susceptible of exact dose regulation. In using it locally and regulating the current strength by means of the spark-gap between the sliding poles, I have devised an adjustment for a "sound deadener" drum which reduces to a minimum the noise of the stream of sparks, and which can be instantly put on the poles and removed by pressing a spring. This is a convenient device for every owner of a static machine to possess."

275. Let us now consider a few miscellaneous features of static work. July of the present year (1900) was hot and humid in New York. During the first half of the month rains that did not cool were frequent and kept the air in a distressing state of semi-saturation. From the second to the twentieth of July, when I left the city on my vacation, there were few days that favored the action of the static machine. The thermometer in the "shade" in my office registered from 90 to 96 or 98 degrees daily, yet during this time my full, thick, multiple spray stream between the static poles was ten inches long. This does not mean the *maximum* spark-gap, but the gap across which the spray discharge was *full and massive.* The efficiency of my machines is never allowed to fail. There are days in the year when I cannot do easily some of the things I can do in winter, but I have proved by past experience that a therapeutic current can be got out of my static machines on absolutely every day of every month in the year.

The moral to the thousands who want to do the same is: "Keep your generator *dry.*" This has been said before, but to me the revelation that comes to me of the average conception of the word *dry* in the minds of physicians proves how difficult it is to teach by words. Strange as it may seem, the new purchaser of a machine is often put directly on the road to discontent by the instructions of an uninformed salesman who ought to take the greatest pains to have his apparatus give satisfaction. Were it not that, as a teacher, complaints and appeals for advice come to me by the score, I could not for a moment imagine that so many physicians throughout the country have so much trouble with an apparatus that in my hands works with adequate satisfaction on an average of five minutes' care per day.

Both as respects *dryness* and *cleanliness* of the static machine the general rule seems about as far from fol-

lowing the plain instructions of my former books as might be a plumber's performance if told to make his hands "surgically clean." A Lister and a farmer are not farther apart in their conception of "clean" finger nails than appear to be both purchasers and manufacturers of static machines and the hard facts.

When an operator writes me also that his machine *reverses* every time it discharges and that it "discharges daily," I need no other evidence that his idea of the word *dry* is not mine. The fact that any operator finds his machine discharged at short intervals without recognizing this appeal of the mute machine for the kind of relief it needs proves him unversed in the sign-language of the apparatus. It is as if a violinist did not heed a broken string, but blindly played on perplexed to find a remedy. Not only will the directions in my former books correct these troubles if they are correctly followed, but I can cite an instance of the stability of the resulting charge which is a far greater test than the requirements of ordinary use demand:

November 14, 1899, a workman came to my office at 3 o'clock P. M. to replace a broken ball on the tip of one of the combs in one of my static machines. The day was exceedingly damp, a fine "drizzle" falling all the afternoon. The workman removed the end doors and top of the case, took out the five stationary plates, disconnected the cross rod holding the combs and collectors on the positive side of the machine, detached all the comb rods and replaced them with new ones. The machine was stripped down to the bare revolving plates and was exposed for an hour and a half, according to the record of the job in my note-book. When the new rods and ball were attached and the stationary plates returned the case was closed and the machine started into action so that the mechanic could test the adjustment. *It had not discharged*, and with the broken ball removed and the full insulation restored, it at once gave out twice the current generated

before the job was begun. A later note in my book records that the machine still held the same charge.

276. Another point is *the utility of the sliding pole pieces* of the prime conductors. I learn that some deem it an advantage to take them off, to "get them out of the way." If they know no way to use them this may be rational, but my experience with their value is different. It would appear to me to be equally rational to take off the fingers of a hand to "get them out of the way" of the thumb. The sliding pieces are both convenient and *indispensable* to all operators who wish to equal my results. Those who omit all the methods of treatment which they enter into omit about one-half of the possibilities of static electricity in expert hands. If that is an advantage you may easily go further and secure a greater per cent. of advantage (?) by dispensing with groundings and electrodes. You can work without them, and so can a one-armed man saw wood, but the man with two good arms can work fully as well and is likely to accomplish more.

The hard rubber handles of these pole pieces should be long enough to let you operate them without sparks with your maximum currents. I have had those on my own machines made eleven inches long.

But it is said that these pole pieces "leak off current." I have seen a defective joint at the rubber handle of a pole piece leak under certain conditions, but I had it repaired and it gave me no more trouble.

"Leaks" are much magnified as a bugbear to the beginner. In simple positive electrification the current is forcibly backed up on the prime conductor and the excess will discharge into the atmosphere wherever it can, and if a point of defective insulation exists there will then be a true leak, but any such point should be repaired. Otherwise what is called "leakage" does not exist in expert technique. The reason for this obvious fact is the law in electrics that a current will take the

path of least resistance and correct technique provides this path.

277. While speaking of leaks (?) let me refer to chains. Some three years ago a so-called safety link chain was introduced by makers with the idea of providing a chain for electrodes and grounding that would not "leak" as the ordinary chain was supposed by some to leak. A moment's clinical demonstration suffices to disclose the drawbacks of the safety chain and to condemn its use. The old-fashioned brass chain is very much superior and its "leakage" is one of the half-dozen imaginary and popular "bugaboos" regarding static electricity.

278. A poor platform may provide *imperfect insulation*, however, and you can test yours on any dark night. There are also a number of platform tests that are useful, to which I shall here refer:

With the metallic tray set aside run a chain around the edge of the platform close to the rim. Let the rod touch the chain at the corner of its contact and test the difference in current-strength between this encircling rim of metal and the rim of wood.

Test the effect of placing the feet nearer and nearer to the chain till they touch it. Also bunch the chain under the chair and test.

As metal is a better conductor than wood, so is *water*. Rest the rod on the bare platform and dampen the surface with a wet sponge or cloth. Note the greater current now reaching the patient than dry wood furnishes. Next lay a wet towel on the platform and employ it as you do the tray. All of these modifications of conductivity come into service at times and should be familiar to the operator.

279. In any form of localizing treatment that is not a *disruptive* discharge a metal conductor under the feet will make no sensation through the soles of the shoes. When a spark treatment is given I find that the soles of some shoes of thick resistance, partially pierced by iron pegs

in the heels and by the metal shank, will spark the feet to the annoyance of the patient. Thin and old shoes do not tend to do this, and in practice the majority of patients have no trouble, but it is easy to test the matter and change to contact through the hands when necessary. In applying sparks with the patient holding the rod or chain note that *both hands* are necessary to comfortably absorb the jerk of the wrist muscles. If the contact is divided and the "jerk" strikes one wrist with double force it is disagreeable and with a strong spark can become painful. Avoid it.

280. During my experience with static electricity I have tried all kinds of platforms, from the straight-edged travesty of early days with its wooden pegs set in the crude glass insulators (!) borrowed from the telegraph, to the modern platform with properly rounded rim and high glass legs. In the summer of 1893, when only the old-fashioned type was to be obtained, I suggested an improved platform with superior insulation for the current and better conduction to the patient. I have in my scrap-book the circular announcing the Monell improved static platform of 1893, as printed by the maker, but the present platform with a chain or metal strip inside the rim would be nearly the same thing. A year or so after devoting great attention to the subject of platform insulation and conduction, I realized that I could make any good platform flexible in its use and increase or decrease its "dosage" at will.

281. How *large* shall a proper platform be? This question is correctly answered by the immutable laws of electric action, but is often answered without regard to them. I have tested platforms of all sizes, from the smallest to the largest in office use. Some employ a platform that will hold two, three, six, or even more at a time; and some have made a combination so that twelve patients can be "treated" (?) at the same time with one machine!

It is the aim of every competent physician to generate a powerful static current for his therapeutic effects, and as it has been recognized that many effects are only possible with great current-strength, the earlier machines of small size are fast giving place to others of fully double bulk. To go back from a 10-plate 30-inch machine to a 6-plate 26-inch machine, such as I once owned and thought good in the days of my inexperience, would be a positive misfortune to me, and so all other experts would regard it.

But this is what every physician does who puts two patients at once on the same platform, for it is the invariable law of all electric currents that to *multiply* the area of action is to *divide* the *density*. Put three or six patients at once on a "wholesale" platform and you need but small knowledge of electrical *science* to expose what you are doing to each.

Make such a test by dividing the density of the positive breeze. Sit on the platform yourself with one breeze electrode on a standard behind your head and another at equal distance in front. Note also that any part nearer an attracting object or electrode than another will be acted on more intensely than parts at the greater distance, hence there is an *inequality in the action of the current upon each patient who shares an electrification with another.* You have already noted the inefficiency of the "umbrella" head breeze electrode as compared with a proper concentrating electrode. But imagine the quality of "treatment" (?) meted out to each of, say, six confiding invalids sitting in line with a "trolley" row of "umbrellas" strung over their hopeful heads and certain that they are being "cured" of consumption, or "kidney trouble" (?), or any one of the lamentable disorders that drive so many to the quacks! Is the imagination of the genuine student of the true science of *electro-therapeutics* able to conceive of such duping of the trust of patients in the name of reputable medicine?

But independent of the question of the quality of shot-gun dosage, in any electrical administration there is also the question of whether it is proper practice to ignore all local and individual indications and literally shovel one formula into all patients by groups, and by the watch. Ten minutes' charlatanism for one group, ten minutes for the next, as fast as the victims of sensational advertising can be passed through the hopper. It is not a pleasant picture to dwell upon, and let us leave it.

282. Among the multitudinous tests which I have been making of every conceivable feature of static electricity for years, not a tithe of which can be mentioned in this book, I recall two that may be of special interest—removal of lacquer from the brass parts within the case, and drying the case by internal heat.

I have exact and full written records of the daily behavior of the tested machine during these experiments, but they fill too much space to insert here, and it will serve the purpose if the results are stated in brief.

I advocate the removal of all lacquer from all *conducting* surfaces of electrodes, and the chains, rod and sliding poles *outside the case* of the machine. I repeat this advice in all my books and in my personal instruction, because the tests of each year confirm its correctness. Lacquer is so great a *non*-conductor that it will, as is well known, stop an ordinary galvanic current, and to my classes I show how much it cuts down even the static current. Some physicians find it hard to interpret literally my directions to cut *all* the lacquer off, and they have removed it only from the point or ball of an electrode, and from but a portion of the sliding poles. This leaves the machine still like a horse with a lame leg.

But to test the effect farther, I had the brass parts inside the case cleaned of varnish and brightly *polished.* The immediate result confirmed the principle that *the better the conduction, the greater the current.* My machine now gave a superb spray stream of seventeen and a half

inches, and my therapeutic results during the next week were the revelation of increased efficiency, on which I have since rested my eagerness for a current of twice the volume. They were so astonishing that the theories of years filled with tests of such *current-volume* as the ordinary static machine produced, fell to the ground, and a new field of possibilities opened up. The voltage or mere length of spark was not so greatly increased (nor did I wish it), but *thickness* and *quantity* of all discharges were nearly doubled. With the case well dried and all office conditions in working order, the machine was now a delight, and remained so for two weeks. Watching it daily, the polished brass that at first shone like burnished gold began to dim as all common metals dim in lustre when exposed to air. Then a film of deposit from the hygroscopic chloride began to coat the rods and combs, and in proportion as *good conduction* was impaired by the tarnishing of the brass parts *inside the case*, the current decreased exactly as it decreases from poor conduction and tarnish *outside* the case. *The principle of action is the same.*

I saw at once that just as the outside parts need to be kept in a state of constant brightness, so the inside parts would need to be kept in the same condition after the lacquer was removed, if they were to retain their best conductivity. I cleaned them somewhat and proved the theory by practice. The current at once improved, but ran down again as the tarnish again increased. In another week the current was too small for any kind of efficient therapeutic work.

Here, then, were two propositions established:

1. A clean-polished bare metal surface of all conductors delivers the maximum current generated by a given static machine, and this current is largely in excess of the output delivered when resisting varnish anywhere in the circuit cuts down the delivery.

2. As at present constructed, the internal brass parts are so difficult to remove and clean, that it requires a me-

chanic and about three hours' time to do it; hence it is impracticable.

Needless to say, the cost and difficulty of frequently polishing the internal parts the same as the external parts are daily polished, make it impossible for physicians to now utilize more than two-thirds of the real current-strength of their static apparatus until the makers remove the mechanical obstacle and make the internal parts as accessible as the electrodes. I made certain suggestions at the time which would appear to accomplish this, but they were not developed by the manufacturers. At some future time I may return to the matter, and try to carry out the improvement.

283. Next to the need of generating the maximum current, no matter what trouble it causes, is the desire to get rid of the trouble and nuisance of chloride of calcium as a drying agent. One of my tests with this in view inserted an electric "stove" and a thermometer in the closed case of a machine and left out the chloride. My written record gives the tests of dryness and all temperatures from 60 to 100 degrees. Morning, noon and evening records were made, and the conditions were carefully studied by me. No degree of mere *temperature* seemed to influence the generation of current. The electric drier was kept at an even heat for a series of days, and no improvement could be noted. The current soon fell to half its normal volume, and then declined till at the end of the test the large machine of eight thirty-inch plates was producing a spark stream only a third of an inch long, and feebler than the miniature charger. For a great part of the time the large machine would not hold its charge, except when in action, and finally it could not be charged at all.

I then removed the electric drier, and put in the old dishes of chloride freshly baked. In one half hour the machine charged and rapidly developed an inch, and then

a two-inch spark, which in two hours became eight inches, and the next morning full normal action was resumed.

It would appear from the net results of my years of experiments with the static machine that the chloride does something more than merely absorb moisture from the air in the case. No other artificial drier appears to create *the same conditions of electrical resistance in the air around the plates*, and it may be set down as settled that under the present conditions of construction and employment, plenty of well-dried chloride of calcium in the case is a necessity. It may also be considered settled that if chloride is used and if the internal brass parts are not made accessible for easy and frequent polishing, they must be protected from speedy corrosion by a coating of lacquer. These are the conclusions of my experience up to the present time. It is to be hoped that improvements will change the facts.

284. I spoke a few pages back of the chief cause of a reversal of polarity in the modern Holtz static machine. I have kept a written record of the reversals of a given machine in my office for five years, and note that a change of charge has never occurred during the treatment of a patient or while the plates were in action. This is a matter of careful and written record, and not an expression of opinion.

A reversal has been rare when the case was well dried, and has been at long intervals during all seasons of the year when furnace or steam heat is employed to warm the house or office. Nearly all the reversals occur during that part of summer when humidity is greatest, and when the trouble of baking the chloride postpones it as long as the current is sufficient.

But, on counting up the total number of polar reverses in a single machine, I find the yearly average to be about thirteen. Of these, it has occurred sometimes that two or three have happened in a single week, warning me that I should no longer defer attention to the chloride.

But when a machine of mine reverses I have also kept a written record which shows that the methods taught by me of calling back the charge to its original situation have always succeeded in my hands. This means that about thirteen times a year for every year since the first publication of my article on "A New and Original Method of Correcting the 'Reverse' of the Positive Static Charge, with Further Practical Suggestions" in the Medical Record, February 24, 1894, I have demonstrated that the method works successfully. As my larger books have not been revised since they were written, they describe only my early shaking of the charges from one-half of the plates to the other by a series of concussions. From the partly revised fourth edition of a smaller work, I take the following extract, written about the beginning of this year—1900:

"A simpler and more direct method of shifting static polarity I now teach as follows: Cleanse the lacquer from the brass rod which projects out of a medium-size Leyden jar, and fix it on a permanent hook of stiff copper wire. When desiring to transpose the positive charge from one pole to the other, draw the sliding poles wide apart, hook the single Leyden jar on either pole, and revolve the plates rapidly till the jar is charged. Then stop the plates and quickly lift off the jar by carefully grasping the edge of the wooden top between the thumb and second finger of the left hand in such a way as not to leak off the current. With the right hand quickly give the plates a few turns backward to discharge the parts within the case, and the instant the plates stop, touch each prime conductor with a grounded chain till the remnant of spark ceases. At once hook the jar on the opposite pole and start the machine into action. Push the sliding poles near together at the same time, so as to tell instantly which is now positive. If the jar was not charged the attempt will fail. If the machine discharges and gives out no current at the final test, simply connect

one pole with the Wimshurst charger, without stopping the Holtz plates, and give the Wimshurst a few rapid turns till the charge appears. The result is usually the one sought. A little practice makes it very simple. If, however, a first attempt entirely fails, it takes but a moment to repeat. The whole process needs quick handling and I have demonstrated *four* complete changes of polarity to a student in ten minutes to illustrate the technique. If the conditions are such that the reversed charge persists despite more than one attempt to correct it, the machine can be used till a more convenient time, when a second application of the method is apt to succeed at once."

285. I should devote a moment to the *intensity* that is *added* to a convective discharge by introducing an *interruption* elsewhere in the circuit. The device is often useful in developing dosage, and should be familiar to the operator. During the same tests study the influence of extra-attraction upon the rate of change of the ingoing current, as the experiment illustrates both features.

Place the standard, with the single point electrode at one side of the platform, and on a level with the patient's chin. Have the patient hold the platform rod in one hand, and rest the crook in the usual manner on either pole. Start the current into moderate action, and request the patient to slowly advance the open palm of his free hand toward the point of the electrode. Note the nearness to which the palm can approach before a spark flies, and observe the quality, voltage and volume of the spark, as well as the general intensity of the preceding spray. Now have the patient draw back the hand a foot or so, and raise the rod so that contact with the sliding pole is slightly broken. As he again advances the palm toward the electrode point, note the effect of gradually lifting the rod higher till the spark-gap is an inch and more in length. Note the intensified spray, the longer, stronger, thicker, more powerful spark to the palm, that

discharges from the point when the plates revolve fast and the interrupting gap is at its maximum. The break and blow in the hitherto even pressure of the current has the same effect that a hammer *blow* has upon an even *pressure* with the same hammer.

Now restore the rod to contact with the pole, and remove the palm as far as possible from the attracting electrode. Again lift the rod and interrupt the current. Does it have the same intensifying effect? By no means. Note the slow feeble spark-gap developed by the same speed of the plates, as before. Hold the rod an inch above the pole, and almost all current is lost; but bring up the palm of the opposite hand again toward the grounded electrode, and note how every inch of its approach *develops a greater energy of current at the interrupting gap and throughout the entire circuit.* The intensity is multiplied many times, and I often make use of this fact in administering certain forms of treatment.

286. Sit upon the platform and repeat these tests on yourself. Test each polarity in the same way, and also here note a remarkable difference in the convective discharges of the opposite poles on bare tissues, without an interposed resistance. If your current-strength is sufficient you find that a spark will fly to the palm yet four, five, or six inches from the electrode, when you are connected with negative insulation. The spray is luminous violet in a dim light, and is long in proportion to the volume of current. Note, also, that by a very slow approach you can coax the palm much nearer to the electrode without a spark, than a quick approach will permit. This last observation is of great importance in static technique, and should be tested in every way.

Note the contrast of action with positive insulation. Your palm readily approaches without either spray or spark to within a fraction of an inch of the point of the electrode. The discharge is simply felt as a cool wind.

When the spark does discharge, it is not in single and thick form, but in a rapid-fire volley of short needles.

The difference in the above respects between the two poles springs from a difference in potential, and nothing else. The lesser E. M. F. of negative insulation allows a greater accumulation of current on the platform and in the patient before the tension of the restraining air gives way; hence the thick discharge of moderate voltage and more fully developed quantity. The "spray" of electrified air is the temporary and partial restraint of the discharge by the resistance, and represents the greater effort of the low E. M. F. to force its way through the *dielectric.* The friction evolves the luminous effects of the spray, and when on still further reducing resistance by shortening the air-gap the discharge is seen to increase its rate of change and the exact point of transition from spray to spark can be observed. The whole phenomena can be beautifully studied in a darkened room.

With the higher potential electrification of the positive pole the plain resistance of air between the excellent electrolyte on the platform and the conducting point of a grounded electrode is so quickly and incisively cut through that friction is at a minimum, the discharge is not broken into a spray, but is felt as a breeze clear up to the spark. The faster rate of breaking down the dielectric lessens the fullness of accumulation, and hence the spark is thin.

A change of the resistance changes the behavior of the discharge. The *luminous* spray appears also when more friction is created, and skilled manipulation of resistance will enable the operator to vary his effects at will.

Note that the positive breeze and spray push against the part to which they are applied *en masse*, while the negative discharge is minutely divided in passing through clothing and thick hair, and is only *en masse* on parts which it reaches without friction.

287. Now, with the head-breeze electrode about two

feet above the head of a person with thick, dry hair, test the "interrupted" negative breeze by the author's method. Have the rod held in the patient's hand and raised from direct contact with the positive pole till the correct dosage is adjusted. Contrast the intensified *interrupted* breeze with the *constant* breeze of direct contact by letting the rod next rest on the sliding pole. A few tests of this kind will teach much.

Now change from *my* plan of making the interruption in *the path of the ingoing current* before it reaches the patient, and make the interruption *after* the current *passes* the patient. For this purpose, a spark-gap device is made to fasten on the standard holding the grounded electrode. Try by this method to secure any *intensification* of the current. There is none. On the contrary, you note that the force of the breeze is considerably reduced, for there is now not only no *extra*-attraction and "*blow*" driving the current at a greater rate of change, but a resistance and impediment has been inserted in the path of the current to the earth, which reduces the potential and impairs the treatment. A single personal test of the method will demonstrate its action.

The other plan of interruption is simply part of my comprehensive system of "Potential Alternation," and is employed in various local applications.

288. In making your ozone tests have a positive spray applied to the tip of your own tongue from a non-metallic electrode, and note the metallic taste set up as by a galvanic current. I would also say that when I wish the strongest ozone spray for external use, this is not to be obtained from the supply of oxygen in the air alone, but I combine the two great sources of oxygen—air and water. By discharging the current through these at the same time, the liberation of nascent ozone is much more rapid.

289. The present hot wave, during which I write this chapter with three static machines in efficient working

order, leads me to suggest that when physicians follow my instructions as to drying the case, and yet report trouble in making treatment produce desired effects, the cause of failure may be due rather to the state of the patient than the state of the machine. For instance, a case of gastric neurasthenia, with tendency to hypochondria and morbid fancies, attended my clinic. I prescribed a *warming tonic spray* over the solar plexus and on the spine, among other things. It was during an early June hot wave, and the man was warmly clothed. His skin was in a state of profuse perspiration, and his shirts were moistened through. The student who essayed to carry out my prescription had been trained in ordinary methods elsewhere, and confidently selected the proper electrode and made the proper connections, but despite persistent effort could not make the spray set up a "warming" action. Through the damp shirts it was cool, and neutral in therapeutic effects. It is perfunctory technique, and not genuine treatment, unless the *essential action* is set up by the technique, and this the physician was unable to do. Probably similar defective "treatment" (?) is common throughout the country during part of each year, yet all my books teach how to avoid the failure.

The same difficulty may present itself in the case of a patient who has walked to the office and been caught in a shower. Whether clothing is dampened by rain or perspiration, the effect is to increase its conductivity and to inhibit the effects which depend on *non*-conduction.

290. I now speak of a matter connected with technique, hard to describe, yet easy of demonstration. It is the art of projecting the mind beyond the mechanism of the electrode into the field of its *effects*. Remember that the static electrode is a means to an end; not the end itself. A violinist does not fix his mind on the bow, he fixes it on the music. The music is the *effect* he is seeking to produce and his mental control of his technique

aims at the *sounds* in his mind, rather than at the mechanics of drawing the bow down a certain distance and then tilting it in a certain direction and pushing it once more to a certain point on another string. Yet allied to such an attempt to play a violin is the technique of every operator who is concerned only with the manipulation of his *electrode* and who does not wield it for desired *effects* as unconsciously as the skilled cyclist riding "hands off" sways his machine instinctively in the direction his mind wills.

The mind of the static operator must take cognizance of the exact *action* he is setting up; must automatically wield his electrode so as to win his desired response from the tissues; must psychologically *feel* every sensation he produces in the patient; must have a conscious recognition of the dosage and must steer his technique instinctively according to the conditions, just as a yachtsman bends his rudder and sails to a shifting breeze so that he finally lands where he wants to.

Persistent personal testing of every form of current action is the only road to a sympathetic understanding of the patient's feelings during local treatment. Different pathological states modify sensations and a normal person cannot exactly repeat all sensations on himself; but by the aid of many personal tests your questioning of patients will more clearly enlighten you and you will be able to mentally *comprehend* what your tissues can only feel in part.

In electrolytic work the sensations of a patient are no guide to dosage, and this is also true of many forms of treatment, but, on the contrary, the extent to which sensation *reveals* what you are doing in much of your local static work is too little understood by the profession. When I know that certain therapeutic actions, especially reflex actions, are associated with certain qualities of sensation I know that when I product the *indicating sensation* I am also producing the *indicated effect.* With my

trained ear reporting to me the local sensation without a word from the patient, I am able to direct the current into the exact dosage required.

In no other field of work is this reflex relation so beautifully illustrated as in spray, spark and frictions, with static electricity. Deviations in the normal quality of nerve conduction express themselves more plainly to the expert operator of the static machine than to any other mode of treatment; and as between a suspected organic lesion and a functional disorder, a study of static reactions becomes often a touchstone to diagnosis.

There is far more to the scientific study of sensation than beginners imagine. Nor is sensation a mere mechanical excitation of peripheral nerves. We have but to note the difference between the hand-grasp of affection and that of a stranger to recognize that the sources of sensation respond to more than the surface touch. Wundt has, indeed, devised "a woof of the sense qualities shot by a warp of the affections," the seven principle threads of which are:

Pleasantness.
Unpleasantness.
Tension.
Relaxation.
Excitement.
Tranquilization.
Depression.

Note that these terms not only describe the qualities of sensory action, but indicate the associated action upon emotions and the central nervous system. To understand the *quality of sensation* in local static treatment is to have a sure guide to the *quality of effects.*

The promptings of the tissues thus often appear in the untaught remarks of patients, as in the following examples:

A young lady, neurasthenic, irritable, highly wrought up, received a sedative spray at my hands on the frontal

region. "Doctor, that feels as if it was *ironing* all the wrinkles out of my brain," was her impromptu remark. Can any one doubt that sedative action induced the sedative sensation?

A tonic spray upon a heavy semi-paralytic arm led a young man in my private practice to remark: "Doctor, that is like food when you are hungry." Why did it *feel* nutritional if it was not so in *effect?* The final results of treatment proved the effect.

"Doctor, that feels like a red-hot mustard plaster, but it *feels good,*" is proof enough that a counter-irritant action is set up; and that it was indicated is proved by the *quality* of the sensation, not by its intensity. When a patient comes to the office on a hot and dusty day, fatigued and reporting great nervous irritability, is given a static treatment and on leaving says, "I feel as if I had had a good nap, woke up, had a refreshing bath and put on a clean suit of clothes," it is not doubtful that his nervous system has experienced the *refreshing effect* that his sensory filaments report.

The production of precise qualities of sensation at the will of the operator is the *artistic* side of technique. That these refinements elude the beginner even after considerable practice and instruction is illustrated daily in my experience. Requesting a young woman on the platform to close her eyes, I direct student No. 1 to give her a sedative spray upon the forehead. His grasp of the electrode is like the grip of the cycling beginner on the handlebars of his machine. His spray is monotonous, and nature abhors monotony. Student No. 2 holds the electrode so far away that he nullifies his attempt at action and might as well make his motions at a stone wall. Student No. 3 is, indeed, different, but no more effective, and it is evident to the patient and to every bystander that neither of the three has any definite idea beyond the crudest mechanics of perfunctory imitation. They saw me move the electrode over the region of the forehead, and as a

child sees its elders write and imagines its own pencil-tracks on the paper are the same letters, so students make the motions without knowing first the alphabet that expresses *electro-physiology* in terms of *technique.* I now take the same electrode and use the same current anl method, but the patient with closed eyes does not see. With light touch and flexible elasticity the point glides to the exact proximity to the tissues that induces the proper *rate of change.* With gentle and rhythmical manipulations the spray caresses the tissues. It soothes them with the lullaby that is projected from the mind of the operator, and the obedient electrode with no tune of its own creates the therapeutic harmony that I inspire—and no other. The patient's face reflects the action of the current. Over it spreads the expression of settled content, of tranquil and ecstatic repose, that tells the story of perfect spray sedation. We stop the spray, tell her to open her eyes and ask the difference. In addition to describing sensations and qualities the patient will say to me: "You handle the electrode as if you were *doing something* with it, and knew just what you were doing." Therein lies the whole difference. To know *what to do,* and know *how* to do it right, is the whole of static technique.

291. As a workman cannot work without tools, so in the use of static electricity a duplicate of my results can hardly be obtained with less than a duplicate of my electrodes. I shall now name the principle static electrodes I employ and indicate their functions:

Spark ball (large)—

For all varieties of sparks, frictional applications, and can be used with "massage-roller" technique.

Spark ball (small) —

Same uses as large ball on a smaller scale.

Spark ball, enclosed in glass cylinder—

For sparks on the perineum, throat and situations difficult of access.

Massage-roller—

For the uses described in this chapter. It does not introduce any new action into the current. It is sometimes convenient and sometimes the reverse.

Combination electrode, so-called—

This long brass rod, with point and ball at opposite ends, serves me chiefly as the automatic interrupter in general "potential alternation." I use it for tests and rarely for a fixed spray, but never apart from its standard. It is entirely unsuited for hand work.

Author's head-breeze electrode, with telescope rod attached to top of case.

For fixed breeze applications to vertex and top of head in general, and to intensify current-energy in my method of *potential alternation.* This electrode and its swinging rod are an indispensable part of every complete static equipment. I should as soon think of omitting the spark ball.

Brass point, large, blunt—

Labile or stabile breeze applications on ary part of the body.

Labile or stabile spray applications on any part of the body.

Frictional applications.

Needle-sparks, fine or coarse.

Long thick sparks, same as from the large ball.

Same technique as massage-roller.

Author's brass point, small, fine—

Similar uses as the coarse point, but modifies the discharge by its lesser carrying capacity. Especially adapted to *fine* needle sparks and to very fine spray when exact localization is required.

Author's multiple point copper needle electrode, large, with detachable central needle—

For general spray and breeze work, especially covering broad surfaces, with powerful discharge.

Needle sparks and even thick sparks can be applied with it.

The fine central needle is especially for sprays and fine needle-sparks requiring the most delicate localization. Frictions can be administered with the rod above the needles.

Author's multiple point copper needle electrode, small, fine—

For general breeze, spray, needle-spark and friction work, similar to the larger electrode above, but affording finer, more intense and exact localization.

Before my creation of these efficient spraying devices in 1893 and my subsequent improvements, there was no static electrode competent for this class of work. The great utility of the "spray" was undeveloped and unsuspected until in my hands and with my improved electrodes it has become the most important and most flexible technique connected with static electricity.

Wood ball.

Wood point.

As ordinarily used these wooden electrodes illustrate that a poor conductor will exert little *attaction* and will cause but little *acceleration* in a local *rate of change*. The *appearance* of action set up by them may deceive the non-expert into supposing that he is getting much more effect than he really is. I, however, demonstrate certain uses of wood which are valuable and unique. The prevalent idea that the function of wooden electrodes is to produce a so-called "milder" breeze or spray than metallic electrodes will produce is an error arising from the extensive and popular ignorance about static electricity. "Mildness" is simply a matter of dose regulation; therapeutic effects are quite another matter.

The author's sparker—

A localizing electrode for the direct static current when interrupted by either a sliding pole spark-

gap, or by an extra circuit electrode, as described by me under the name of "potential alternation." It serves many local purposes of great value, but is by no means the only localizing electrode to be used with this system of action. Originally devised by me in 1893 it has become after years of experience one of the most useful instruments I have so far given to electro-therapeutics.

Fan brush—

A brass handle terminating in a flat "fan" of steel wires about five inches long and flaring like a small fan. It is the "wire fly killer," patented January 8, 1895, and sold by house furnishing stores, except that the entire handle is metal instead of being part wood. The fine wires will discharge a breeze or spray. The brush may be fanned up and down a part, as, the spine, and a modified needle discharge, similar to "frictions" will result. As a breeze or spray electrode the fan is not so good a conductor as my copper point electrodes and is inferior to them for several reasons. As a means of producing counter-irritant friction effects it is less useful than the regular electrodes, which permit of more accurate and versatile manipulation. It is without advantages.

Author's set of mono-polar rectal electrodes—

For use with my interrupted static current. Possess unique utility. See technique elsewhere in this chapter. Can also be employed with other currents by bi-polar methods. The set consists of six assorted bulbs attachable to a hard rubber base. Scarcely any more valuable contribution to local static therapeutics has been made than is represented in the possibilities of this set of electrodes.

Author's water-bath tub—

For bi-polar and mono-polar treatment of the upper

and lower extremities by the author's technique. This devise is as essential a part of static equipment as is the spark electrode and enables me to secure effects that no other technique will duplicate.

Author's insulated electrode handler—

I still have in daily use the original instrument made for me in 1893. Makers asserted that an instrument for the purpose I desired could not be designed. The idea still prevails that it is *unnecessary*. Few have procured it, for it is not furnished gratis with the machine, and still fewer have learned how to use it properly. I have no intention to exploit the merits of my "handler" and seldom mention it in my writings; but will take this opportunity to say, once for all, that if there are 3,525 static machines in use in the United States at this date, and if but twenty-five of them have my handler and use it as I have taught them, then *not one of the remaining 3,500 can approach my full technique or the extensive range of my therapeutic effects.*

Paddle electrode with long hard rubber handle—

For use as a labile electrode in a bi-polar arm or leg bath, and for various labile applications with a fine Leyden jar current.

Two glass jars, about fourteen inches high and admitting a man's hand.

For use with interruped static current, as described elsewhere.

Two straight sided crockery pitchers holding about two quarts—

For localizing high-frequency applications, especially adapted to the small joints of the hands.

Two foot tubs—

For similar treatment of the feet and lower extremities. With these water-bath applications my "sinkers" are essential.

An extra piece of chain—

To wind around local parts in connection with my static interrupted current. My first use of chain for this purpose is recorded in my case-book as June, 1893.

A roll of tin-foil—

This I cut into strips as needed. Have used foil for contact since 1893.

One hard rubber universal electrode handle 15 inches long—

To this I attach any sponge-covered labile electrode quired for use with my static interrupted current when I need to manipulate it personally.

A variety of such electrodes as are used with faradic technique. These serve with my interrupted static and with Leyden jar currents.

Author's insulated hook—

A convenient device enabling me to handle charged conductors during various experiments without sparks to the operator.

Muffler, with author's device for instantaneous adjustment—

A hard rubber drum to muffle the sound of the *shunt rheostat* spark-gap when using an interrupted static current. By my hinge and spring device the muffler can be put on the sliding poles or removed in a single instant. Thick, hard rubber is essential. Pasteboard drums do not deaden the sound.

Large brass foot plate—

For use on the platform in making metallic connection with the patient.

Large reservoir foot electrode—

This is a very important electrode. Is filled with warm water and placed under the patient's feet in certain forms of treatment, during which the shoes are removed.

292. It remains to be said that certain of these elec-

trodes that have been devised from time to time by me have been afterwards made for others, with more or less disregard of my original standard. It is also to be noted that none of my three copper-needle spray electrodes come from the workman's hand ready for my use. The larger one requires a finer polish on the points and the small hand electrode requires both polishing and shaping of the needles, which are usually delivered in a compact bunch. All of these electrodes require regular care to remove dust and tarnish. A powerful and clean spray, free from irritating discharges, is one of the foremost needs in static work, and dust or tarnish on a spray electrode produce friction, impair the necessary lubrication of the surface, and hurt the spray.

For several reasons, therefore, I cannot be responsible for any of the numerous electrodes and accessories identified with my name, except those actually in my hands. Even the X-ray tube which I standardized for the static machine, soon wandered from my original specifications, and has pursued an independent career. Occasionally, also, an improvement occurs to me, and my own electrode is altered, while general orders may continue to be filled on the old lines. It will thus be seen that a full and exact duplicate of my static electrodes, *as they stand at this date*, must be in the hands of very few physicians anywhere, and those only who have attended my most recent clinics.

I am accustomed, also, to adapt "home-made" devices to unusual cases, and in emergencies adapt other electrodes to purposes beyond their original intent.

293. Let us now give a passing glance at our old friend "suggestion" and the alleged "psychic effects of static electricity." You all remember them. They indeed, show signs of age, but still do yeoman's service in the ranks. When retirement with a pension will be their lot is not for mortal mind to say, for too much printer's ink already stands for their perpetuation. I do not hope

to make headway against these errors, since those active in repeating them bestow no activity in search of the truth; but, nevertheless, I will cite here three instances in which suggestion must have played small part:

a. I placed a young and very wild rabbit on the metal tray in the center of my static platform. Holding him forcibly with my left hand he struggled vigorously to get away, while I started *positive electrification* into action. When the current had developed a full charge I let go of the rabbit. He at once sprang to the edge of the platform, sniffed the air, drew back, darted to another place, sniffed, stuck out his nose as he ran round the rim seeking a point of escape from "suggestion" (?) and then went to the center of the charging tray and—sat calmly down. There he contentedly continued to sit while the electrification was maintained. Three or four persons present noted the "psychic influence," and remarked upon it. After ten minutes I stopped the machine to see what the rabbit would do. As soon as the plates came to a standstill he got up, sniffed the air, ran to the edge and off the platform without hesitation, and dodged about the room to avoid capture.

b. A baby seven months old, a case of blepharospasm, was brought to my clinic by a German woman speaking no English. A physician took the child on the platform, pinioned its hands, and held it for my spray application upon the eyelids. In the grasp of a stranger, the infant cried before the current was started into action. The moment the sedative spray reached the lid of one eye she hushed into a calm like that of nursing. When I drew back the electrode she cried again. When the spray once more "suggested" to her the timeliness of drying her tears she did not hesitate to do it. When the treatment was over she cried till she got in the maternal arms again. What a beautiful illustration of the "psychic influence" of static electricity upon early childhood!

c. An Italian, unable to speak English, was brought to me from a hospital with impaired mobility of the arm. Three months previous he had dislocated the shoulder joint. He was seated on the static platform with his back to the operator. He could see nothing of what was done, and not a word was spoken. While I personally applied a few tentative sparks upon the spine and on the affected arm and shoulder, he sat serene and content. Leaning forward and glancing around to the front I saw that he was smiling. Without intermitting the treatment, I passed the electrode to a student at my side to do exactly as I had done with the sparks. The patient did not see the transfer. No remark was made by either of us. In five seconds the Italian began to squirm. He twisted his back as if something "suggested" to him the idea of wanting to get away. Looking around at his face I now saw no smile, but an expression of "psychic influence" of absorbing interest. There was no doubt about it. His back soon responded so powerfully to the continued "suggestions" of this "psychic" agent that I had to take possession of the electrode to restore order.

Thus we see a rabbit, a baby and an Italian equally succumbing to the "moral impressiveness" of the static machine. Hundreds of patients each year afford further proof in the same direction.

294. In conducting the physician of this date through these "word-clinics" in electro-therapeutics, I take it for granted that he wants to learn. The practitioner of today cannot be satisfied with the standard of general knowledge fifteen years ago. The net sum of *theoretical* knowledge is not much greater now than it was then, as is well shown in the introductory chapter of my "Treatment of Disease by Electric Currents," but there is certainly a growth in the requirements of electro-therapeutic *practice*. We are expected to make better use of theory as we obtain better means of applying it.

A manufacturer from a large Western city recently told me that fifteen years ago he could hardly sell any kind of a battery to anybody but a quack. To-day some of the best physicians in his city and State were his customers. With better customers he was able to make better goods, and the general improvement in apparatus in ten years has been marked. The next stride forward in general advance will be along the line of learning how to *use* the improved apparatus. So long as it is common for mere purchase to end the transaction, and while the majority of patients treated (?) by electricity are treated by men who have made no well-directed study of scientific electro-therapeutics, progress will be slow. But there is progress. At least there is more business. Yet business that leans on ignorance is not permanently satisfactory. Not very long ago a physician called at my office to see if I knew of any one who would like to buy a new static machine cheap. He had bought a fine machine three months before. For two of the three months he had got no current at all out of it. He was disgusted with it, and would "throw away a third of the cost."

What was the trouble? Had the machine any defect? None that appeared. Did he know how to operate it properly? Well, about like any beginner who "picks up" his information. Had he taken any clinical instruction? No. Did he have my book on the subject? No. Had he studied the subject in any way? "Why, what was there to learn about it?"

There are hundreds of similar cases all over the country. The cost of a course of instruction would have been paid twice over by the loss he was willing to accept on the price of his useless purchase, but he did not want any instruction. It was of no moment that he could make the machine earn several times its cost every year after he learned how to use it. All he wanted was to get rid of it. I have no doubt that fully one-half the buyers of

static machines are disappointed in them, but until a reformation comes into the professional attitude towards study of the subject, there will be a large number of disgusted patients lost by abuse, and a considerable number of physicians who sacrifice their opportunity.

CHAPTER VI.

LIST OF SPECIAL METHODS.

Chief Methods for Use in Electro-Gynecology.—Author's Complete Methods in Functional Sexual Atonies, Debilities and Other Deviations from Health.—Chief Non-Surgical Uses of Electricity in Eye, Ear, Nose and Throat Pathologies.

In a few great fields of electro-therapeutic work, I will now name the methods of technique which the physician may practice until he is sufficiently familiar with them to competently treat patients. Effects vary with degrees of dosage, and tests should cover the range of current strength.

ELECTRO-GYNECOLOGY.

Faradic and sinusoidal currents—

1. Vaginal bi-polar faradization.
2. Vaginal mono-polar faradization.

Practice dosage and technique for different effects—analgesic, anti-congestive, tonic, sedative, alterative, nutritional, muscle-contracting, stimulating, etc. Sinusoidal methods are exactly the same, the factor of *quality* being taken into account in the dosage of each current.

Galvanic currents—

Polar variations and dosage with the following methods:

1. Percutaneous (pelvic).

Constant current.

Interrupted.

Swelling.

2. Vaginal, carbon ball.
   Constant current, positive and negative.
3. Vaginal hydro-electric douche.
   Effects vary with polarity, dosage and solution used.
4. Intra-uterine.
   Constant current, positive and negative. All doses.
5. Electrolytic applications—
   Positive metallic electrolysis.
   Iodine and K. I. electrolysis.
   Negative electrolysis for dilatation.
   Negative electrolysis for puncture.
   Neg. electrolysis for nutritional alterative effects.
   Neg. electrolysis for resolving and softening actions.

Supplementary to these local methods are also important static methods. While the above are few in number, I may point out that the fingers of the hand are also few in number, but the uses thereof are great and many. It may also be remarked that some people can use their hands more effectively than others. Each of the above local methods can be shaded into a score of variations.

GENITO-URINARY.

In the genito-urinary field, I demonstrate six electro-therapeutic methods of technique directed to the rational and efficient treatment of sexual debility, functional impotence and non-surgical prostatic conditions; the restoration of local nutrition, muscular tonicity, and vigor in cases of sexual debility; the successful treatment of atonic states of the male sexual organs, including prostatic irritability and congestions, removal of effects of masturbation, temporary sexual excesses and early stages of atrophy of the testicles and penis.

Two important methods for the relief of pain, irritations, congestions and certain other states of the rectum may also be considered under this head.

1. Spinal; coil or sinusoidal currents, with variations—

Bi-polar labile—stabile.
Mono-polar labile—stabile.
Rapidly interrupted.
Rapidly interrupted, swelling.
Dose to tone muscles, nerves, circulation; eliminate local congestions, tenderness, pain, etc.

2. Spinal; galvanic current—

Positive, labile, with negative over solar plexus.
Positive labile, with negative to G. U. organs.
Positive stabile on lower centers.
Constant current.
Constant current, swelling.
Constant current interrupted by tip.
Constant current interrupted by rheotome.
Constant current interrupted by rheotome. Test and vary rates, slow to fast.

3. Combined galvanic and coil currents (tonic).

Lumbar spine to genital organs:
Constant.
Interrupted.
Swelling.

4. Galvanic, coil, or sinusoidal currents.

Lumbo-perineum application.
Stabile.
Labile.
Constant.
Swelling.
Interrupted.
Dosage and technique to be regulated for sedative effects, circulatory effects, muscular effects, nerve and nutrition effects.

5. Coil, or sinusoidal currents—

Lumbo-prostatic application.
Constant.
Swelling.

Interrupted.

6. Static electricity—

Author's sparker on perineum.

Sedative, or stimulating, sprays on perineum.

Muscle-contracting or stimulating sparks on perineum.

Author's interrupted static current to spinal centers.

7. Coil and sinusoidal currents—

Mono-polar rectal application.

Constant.

Swelling.

Slow tip, make and break.

8. Interrupted direct static current.

Author's set of dilating rectal electrodes employed by author's method of interrupted static current. One of the most important varieties of special static technique. Employed without exposure of parts and with unique comfort and benefit in suitable cases.

Much of the disappointment to patients in this branch of work is due to an incomplete equipment of currents and lack of skill in technique. I see no reason why results in this class of cases should not average as well as in electro-gynecology, in which brilliant results are the rule among competent practitioners—certainly the rule in my own experience. If, however, I had only a galvanic and common faradic battery, I would not treat many sexual derelicts, but with an armamentarium embracing all currents, these cases may be accepted as confidently as the family physician accepts other chronic but curable conditions. Granted the proper skill, then perseverance is the essential factor in a final "cure."

During the past three years I have profited much by experience in the treatment of functional disorders of the male generative apparatus, and am now rarely disappointed in the results of methods selected from those

above specified, selected according to the needs of the individual patient.

Eye, Ear, Nose and Throat Methods.

1. Stabile galvanic current to eye—
   Positive and negative.
   Constant.
   Slow reversals.
   Cautious dose regulation.
2. Interrupted galvanic current for muscular contractions. (Lids.)
3. Metallic electrolysis to conjunctiva.
4. Anæsthetic cataphoresis to tumor on lid.
5. Stabile induction coil current to eye—
   Rapidly interrupted for sedative effects.
   Slowly interrupted for muscular contractions.
6. Static spray to eyelid for sedative or tonic effects.
7. Needle sparks to eyelid for tonic, or muscle-contracting effects.
8. Sedative or tonic spray in auditory meatus, or to front or back of ear.
9. Galvanic current to ear—
   Constant, with very cautious dose regulation.
   Positive and negative.
10. Vibratory sound waves to ear via telephone receiver operated by coil.
11. Sedative-tonic and nutritional rapidly interrupted fine coil currents to mucous membrane of nose and throat by author's method. (Water contact.)
12. Cupric electrolysis to mucous membrane of nose and throat.
13. Constant galvanic currents to nasal cavities by douche method.
14. Interrupted galvanic currents to nasal cavities by local electrode.
15. Ozone application to nares by author's method.

16. Author's methods of static sprays and needle sparks over external nose and frontal region.
17. Static sprays, frictions, needle sparks and single sparks, over all parts of the external neck and throat.
18. Mono-polar and bi-polar applications to the larynx or other parts, with sinusoidal, induction coil, or Leyden jar currents—

    Rapidly interrupted.

    Slowly interrupted.

    Swelling.
19. Author's interrupted direct static current, localized on different parts of the vocal apparatus and sides of neck.

Practice each of the above varieties of application. Test every alteration of dose, every degree of pressure, every rate of change, the management of the "indifferent" electrode and the patient, until you become so expert that your technique will inspire confidence in those who seek relief at your hands. Having once mastered all methods, the selective use of any one of them to meet indications presents no further difficulty.

CHAPTER VII.

CANCER OF THE TONGUE. DECISIVE PALLIATION WITH STATIC ELECTRICITY.

A Clinical Record Setting Forth Results.—An Important Contribution to the Treatment of Malignant and Non-Malignant Ulcerations.

Any physician who will go to the library of the Academy of Medicine, and make an attempt to satisfy himself with the literature of epithelioma of the tongue, will need no excuse from me for reporting this single case in the permanent record of a book where it can easily be found when wanted. Moreover, in my "Manual of Static Electricity" (1897), I state that the only function of this current in epithelioma is possible relief of pain. With the ripening of skill and the instruction of experience I have since learned that much more can be done for such a sufferer than I formerly considered possible, and I wish to revise the statement of my earlier book.

April 11, 1900. Mr. G. S. J———, age 51 years; married. Has three grown children. For many years smoked six or seven, and of late years, from twelve to fifteen, cigars a day. Stopped when cancer was diagnosed. Other habits excellent. No venereal history. A younger brother died November 12, 1887, of cancer of the tongue, eight months after first notice, and three months after operation by a leading New York surgeon. States that no relief followed the radical operation; his brother remained unable to speak and without relief of pain, and rapidly failed. Has refused operation because of his

brother's experience and advice. Examination showed epithelioma of left border of tongue, beginning a half inch from tip and extending back two inches. Was one inch wide at middle third, and deeply excavated posteriorly. It had a raised, everted, uneven margin, and irregular, exuberant granulations. Was surrounded by a zone of induration, and the nodular mass of the tumor looked irritable and malignant. The floor of the mouth was infiltrated; frenum much swollen; sublingual glands enlarged and hard; sub-maxillary gland large as a pigeon's egg; parotid only slightly affected. Tongue fixed and powerless; could not lift to his teeth; impossible to protrude it for examination. Neck muscles indurated, stiff and sore; could not turn head freely; skin sore to touch; dreaded to shave. Face emaciated and anxious; eyes yellow, marked cachexia, mind utterly despondent. Had lost thirty-five pounds in last seventy days. Pains had been *severe* for six months; "burning" in the tumor and "sharp and shooting" over the distribution of the fifth nerve; often involved head and entire body clear to feet. Complete aphonia from April 6 to date of visit; obdurate insomnia; complete anorexia; food disgusts; for six months has not been able to masticate meat and swallow it, owing to fixation of tongue. Fetor and bad taste make nearly all foods repulsive. In addition to agonizing pains has suffered from active salivation, soaking nightly eight to ten large pads of thick absorbent cotton. Began morphine six months ago; three months ago his physician began local use of 5 per cent. cocaine solution. Diet chiefly whiskey, eggs and such liquids as he could take when relief permitted.

It had become impossible to obtain relief from drugs. He would soak his entire tongue as deep as he could get it into cocaine for two hours without affecting the pain at all. Spends his entire day painting the tongue with cocaine solution. Narcotics had ceased to afford sleep, and he would begin at 7 P. M. to sip whiskey, often "taking

nearly a quart bottle" before he could finally get asleep. Complained of extreme exhaustion; was "worn out"; could barely get to my office; so weak and emaciated was he that a fair prognosis gave him not more than a month of life. The extensive glandular involvement indicated grave mutilation in case of surgery, and my sole effort at first was directed to relief of pain. No assurances whatever were given him. He received no suggestions or promises of benefit. My hopeful experience with tuberculosis of glands and skin, with chronic ulcerations; with a cancer of the rectum, the pains of incurable pathology, and many conditions associated with great exhaustion and grave suffering, led me to turn to static electricity. It was effective. Results of treatment after coming to author have been as follows:

April 11. First treatment removed all pain, stiffness and soreness of neck muscles and sense of fatigue, and refreshed the exhausted nervous system. I urged him to stop all cocaine, whiskey and drugs, and to take all the liquid nourishment he could. He declared that he could get no sleep at all without whiskey, and could swallow nothing now but whiskey and eggs. He was advised to try, and report.

April 12. Reports that he left my office at 5 o'clock P. M. yesterday free from pain, and got better all the way home—an hour's journey. The sub-maxillary enlargement has reduced one half, the neck muscles lost their "hide-bound" feeling and were free, and he could *move his tongue*. Some power of speech returned, and he felt stronger. Slept three and a half hours without whiskey or cocaine; woke at 1:30 A. M., and had some pain, but soon slept again, and did not awake till morning. Went to business and had no pain till 9 o'clock. Got through the day with but one application of cocaine.

April 13. Reports that on reaching home after second treatment he felt drowsy and retired at 8 o'clock. Slept naturally till 5 A. M. without drugs or pain. At 9 A. M.

pain returned severely, and had to use cocaine all day. Upper and lower teeth (bicuspids) indented the tumor and made it very sore. Treatment removed all pain and soreness. Came in exceedingly exhausted by his day's work, and left with the following remark to a physician present: "I feel refreshed, as if I had just woke from a nap, had a bath, and put on a clean suit of clothes." A few moments after treatment he met an acquaintance, who at once came to me and reported: "I have just met Mr. J———; the change in his face is like that of a man who had been under sentence of death and has just got notice of a reprieve."

April 14. Poor report. Poor sleep; much pain. Had to drink whiskey and use cocaine. Face pale; is very nervous; *fainted* before he was half through treatment, and was dismissed as hopeless and not asked to return again. I never expected to see him after this visit. His grave condition seemed beyond relief. Two physicians present shared this opinion, and remarked that he would probably never again get here. This was his last use of whiskey.

April 17. Returned for fifth treatment, with a fair report. Had less pain. Though wakeful at night, has been fairly comfortable; seance relieved all disturbing symptoms.

April 18. Reports: Has used no cocaine for two days, the first time in three months that he was able to omit its use. Slept well without whiskey. "Is getting a big appetite." Voice growing fuller and stronger, and he uses it all day in Stock Exchange telephone work, which is a great strain. Still talks as if tongue-tied, but enunciation is good. When he reaches home he feels like a nap; gets one, and awakes refreshed. On inspection the epitheliomia looks paler and less irritable.

April 19. Good report. No cocaine; fair sleep; can protude tongue a half inch over teeth. Has gained eight pounds in weight. Salivation has changed in quality.

Is getting more mucous and less watery. Salivation is now his "chief trouble" at night, but he soaks only six Turkish towelling squares instead of ten pads of absorbent cotton.

April 20. Eighth visit. Pains are slight and rare; sleeps well; estimates tongue to be 25 per cent. smaller than before coming to me. It looks on inspection as if *cicatrizing* at anterior margin. Can rub neck muscles and shave without soreness; can protrude tongue beyond lips; appetite A1. No more fetor or foul taste since first visits. Teeth do not now dent tumor or make it sore. Salivation is reducing; glands are smaller; color of face markedly improved. "Has had three days of great relief and comfort." As he has entirely stopped all use of whiskey, cocaine and other drugs and does not miss them, no further reference to them will be made unless he relapses. He "enjoys his treatment" and is eager to receive it.

April 23. Held up well during the three days since last treatment, but "touched the tip of his tongue once with cocaine," and was sorry he did it, as the pain was but momentary. (This was the last use of cocaine up to date of writing.) Eats and sleeps well. "Sleep is natural and restful."

April 24. Face now shows animation and decided gain in color. Gain in condition and in all symptoms goes on. Pain very rare and is only a sharp dart at long intervals; salivation getting less. "Enjoys seance." Voice has improved noticeably during last three days. Glands are very small now on palpation.

April 25. Eleventh treatment. Good report. Has had a few sharp, shooting pains in fifth nerve; weight, 138 1-2 pounds, a gain of ten and a half pounds in thirteen days. Good appetite and relish for food. Eats nourishing soups, eggs, bread and butter, vegetables, strawberry shortcake, cereals, milk, etc., "but has not tried beefsteak yet." Sleeps well; is more vigorous and is losing

the cachetic facies. Examined to-day by Dr. H., who was present April 14, when Mr. J. fainted. Dr. H. noted "a great improvement. Tumor appeared smaller, paler and as if *cicatrizing.*"

April 26. Gains decisively. Uses voice all day from 10 to 3 o'clock, and gets tired; but each treatment refreshes. Can get no change in occupation, and must work hard or lose his place. Articulation sounds less and less as if he held a pebble in his mouth. The granulations of tumor look much less exuberant, and color has paled still more. Mobility of tongue increased. Can now open mouth wide and manage tongue so as to permit better examination and more thorough treatment.

April 27. To-day at lunch he ate "a large plate of roast beef" for the first time in six months. Head and neck freely movable in all directions. Glands reduced to a mere shot in size, except the sub-maxillary, which is still about as large as a pea. The whole glandular involvement and infiltration around tumor has been so far controlled, reduced and relieved of symptoms. Salivation is reduced remarkably. Last night he only used "one square of towelling on pillow, instead of six, required two weeks ago." Mental state and physicial condition are convincing proofs of the decisive palliation secured. Mr. J. feels as if there was "a third less tongue in his mouth," and the former swollen state has been removed. Three close observers estimate that growth is reduced one-third.

April 28. (Fourteenth treatment.) Last night retired sleepy at 8 o'clock. Slept till 3 A. M., woke up, turned over, shifted towel under cheek, and went to sleep again at once. Did not wake till 5:30 A. M. Reports: "Tongue has a sense of *contracting.* Feels as if it was getting smaller daily. It has never felt so well before since I was first sick. Am losing all tired feeling. Fetor of breath has been practically absent. My coming for treatment is like a calf running to its milk. While being treated I am in clover. The benefit is so decisive that I

am a surprise to all my family. My oldest boy said last night: 'Don't you think you ought to go sit on the sofa and have a talk with yourself to see if you are the same man that was around here two weeks ago?' "

At this date the palliation secured presents the following features:

Relief from the constant agonizing pain and suffering.

Return of appetite, relish for food and power to eat a mixed diet.

Return of natural sleep without narcotics.

Return of speech and use of the voice.

Control of salivation to nearly normal.

Deodorization of fetor.

Reduction of infiltrations around the tumor.

Lessening of cachexia.

Omission of all drugs.

Emaciation stopped and gain in weight.

Improved mobility in tongue and neck muscles.

Mental state changed from utter despair to comfort.

Physical state changed from profound debility to capacity for active work.

Reduction in size of tumor fully one-third.

Before coming to me this case was seen or treated by seven physicians (patient's statement), and while under my care has been examined by ten others. The therapeutic actions at work appear to be of a nutritional character. *General* technique has been directed to improving general nutrition and innervation. *Local* technique has been directed to meet local indications. Improvements have been in response to direct methods. Ozone has been a factor in deodorizing, and probably in other ways. All drugs were withdrawn, as per above record, and the sole means of treatment so far has been *static electricity.*

April 30. Reports: After last treatment went home and to bed; had four hours' good sleep; woke at 12:30 o'clock with shooting pains from occiput to vertex. Made him very nervous. Seemed to start from sub-maxillary

gland, which got suddenly large and very hard. Pain lasted twelve hours, till noon yesterday. Then (Sunday noon) he took a bowl of soup, lay down and slept till 5 o'clock P. M. Used no drugs. On awakening, posterior scalp was sore to touch. Hurt to comb hair. Tongue gave no distress, but a tensive drawing towards sub-maxillary gland gradually increased and became annoying, and has continued to-day. Yesterday A. M., on rinsing out mouth, he discharged a little clotted blood for the first time. It relieved the pressure. Last night slept from 8 P. M. to 3 A. M., and then cat-napped till morning. No pain. Feels first rate to-day, except the drawing on side of tongue and soreness in scalp. The lingual gland cannot be felt now. Feel one small gland behind angle of jaw. Did not lose strength. "Pain" now means moderate pain, and he never again suffered the prostrating and agonizing pains that were abated by my first treatment. On careful examination to-day by three physicians present, decided reduction is noted, chiefly in width and thickness. The whole mass is certainly one-third less than on first visit. Treatment relieved all symptoms, softened the sub-maxillary mass and reduced it to size of pea. Left office feeling A1.

May 1. Extension to sub-maxillary aggravates. Had no pain in tongue, but was wakeful and distressed in head, similar to last report, though much less severely. Salivation is not increased, and no longer amounts to anything. Weighed. Lost two and one-half pounds, accounted for by diminished appetite and nutrition during the three days of aggravation. Treatment gave entire relief from local symptoms, with a general tonic effect as usual. After seance the sub-maxillary mass was reduced to the size of a shot.

May 2. Reports: Again hungry and eating well; slept A1 from 9 P. M. to 5 A. M. Salivation nil. Very much less of the occipital soreness.

May 3. Slept A1; salivation normal; did not use any

towel to protect pillow last night. Hungry and relishing his food. No shooting pains. The most comfortable three weeks he has known in a year. Does not miss cocaine or morphine, and feels much better since he stopped them. Is now up to his best state of improvement so far. Left feeling delighted with his comfort.

May 4. Best report yet. No salivation last night. To-day had a few shooting pains and a little soreness of scalp, but whole condition is fine. At lunch ate large plate of roast beef, vegetables, strawberry shortcake, etc., making a hearty meal. Tensive drawing on tongue is absent; has a continued sense of reduction in size of tumor; it looks less irritable; has gained greatly in vigor; facies show marked improvement; cachectic appearance almost gone; voice clearer; articulation quite distinct; is now in better state than last November, when his rapid down grade began.

May 5. Slept O. K. Some gelatinous saliva collected in mouth once during night. Eats well. To-day had quite a good deal of shooting pain and some burning on front of tongue. Occiput sore also. No relapse, and on the whole not a bad report. It seems proved so far that treatment can keep him practically free from pain, and can abate and nearly control all the symptoms of his cancer. Has been examined at almost every visit by other physicians, who concur in saying that they never heard of equal palliation.

May 7. Saturday P. M. rode home in open car; day chilly; caught cold; felt nervous aggravation; "tongue itched as if healing"; had increase of gelatinous saliva; took no drugs; craves something soothing in his mouth, and now uses listerine, 1-5; formerly used dilute carbolic, but since beginning static has had no need of any mouth wash till now; Dr. ———, who saw Mr. J. two weeks ago and to-day, notes "decided improvement in physical condition and color of face, and in appearance of tumor. The neoplasm looks paler, less malignant, and as if it was

healing. There is a marked reduction in size." At this seance three other physicians concur in the above. In the tumor itself the white punctuate granulations and the dark bluish areas are gone; the large excavation is reduced one-half; the color of the mass is modified to nearly that of normal mucous membrane; the inflammatory appearance is wholly absent, and sensation is returning. Previously, he would not have felt a hot iron; now feels each application of mild static.

May 8. Wakeful last night without apparent cause; tongue gave no real trouble; scalp sore to-day again; his most exhausted day since first week of my treatment; loss since last weight half a pound; had fetor once to-day for first time since April 12; facies anxious; sub-maxillary mass hard; it is always reduced by treatment to a fraction of size before seance, and is softened, becomes almost absorbed while recumbent in bed, but gradually fills up during the day till he arrives for treatment at 4:30 P. M. This behavior of the yet small mass indicates that it is an infiltration and not new growth. The day has been humid, hot and trying to all, and his work is especially taxing to a man in fair health. He operates a Stock Exchange telephone from 10 to 3 o'clock, and not only has to talk and repeat orders constantly, but is under great nervous tension to avoid mistakes. He laid off from this work when his voice failed before coming to me, but two treatments so far toned his vocal organs that he resumed work, although he talks now as if somewhat tongue-tied. He is also bookkeeper and manager of a department, and does a severe day's work by the aid of the general tonic treatment which I add to my local applications. To-day he was asked by a visiting physician how the relief he formerly got from anodynes compared with the relief derived from static electricity. He said: "There is no comparison. To get any relief from drugs had become a constant fight. I have soaked my tongue in the cocaine solution for two hours before it would begin to take ef-

fect. In the evening I would begin at 7 o'clock, and it would be 11 or 12 o'clock before I got enough whiskey and cocaine to let me get to sleep. I felt worse for the drugs, but could not do without them. While they dulled the pain for a time, they set up an awful state of discomfort, so that I was failing rapidly. I do not see how I could have lived a month longer in that way. Now I get a perfect relief in five minutes that is like nature. It makes me feel naturally well and refreshed and the benefit lasts longer than the drugs I used. After drugs the pains came back as bad as ever in a couple of hours. After this treatment the first two or three times they have never been so bad and what little pain I have now is nothing."

May 10. Having had two wakeful nights he was so sleepy when Exchange closed that his employer let him off early to go home and sleep. He slept till dinner, and after dinner went at once to bed and slept finely till morning. Had some few shooting pains in tongue and a little soreness in scalp. Was also a little tired, but reported on the whole a great amelioration of all his symptoms. Has a better color in his face and says that the tongue feels constantly as if "healing." Left feeling best of any recent treatment. Is eating well, good appetite and relish for food, gains a little in control of tongue and articulation. Has caught up all he relapsed and more.

May 11. Best report yet. No pains; good sleep; good appetite; good energy. Had more salvation last night than of late and used two towels on pillow, but did not soak them much. "Has not had an hour or minute since last treatment that he has not felt himself getting better." The tumor itches and has sensation in it now. Facies has no appearance of "cachexia"; looks like a man who had been sick and was still wasted, but the sallow cachexia has given place to a good color. The sub-maxillary enlargement has given no trouble. Is delighted. Dr. ——— examined sub-maxillary mass and stated that it

was not more than one-sixth as large as when he palpated last and it was also softer. Mobility of tongue is slightly increased. This begins his second month of treatment with static electricity alone.

May 12. Last night slept nine hours without waking; woke with bad taste in mouth; tumor also began to burn; fetor, burning and the bad taste recurred at moments several times during the day, the burning being worse than before in two weeks. Is also tired and his eyes ache. Troubled with flatulence and indigestion. (Ordered prescription, which he took for a few days.) Local treatment always stops the "burning" when he brings it to the office in less than thirty seconds. Can protrude tongue half-inch beyond lips, but cannot lift it. Feels tied to floor of mouth. The tumor on the tongue, which I can directly reach by my local application, is growing paler, smaller and smoother. But the thick mass under the side of the tongue in the floor of the mouth and with glandular extension is not reducing and I cannot reach these tissues directly. The action of the current on exposed tissues is remarkable and seems decisively controlling, but where I must treat the parts through skin and muscles the effects seem little more than relief of symptoms. To-day "felt like a new man." Has gained back his late loss of weight. Sub-max. to-day was hard and size of large pea. In his straight nine hours' sleep last night he did not wet the towel on his pillow with any salivation.

May 14. Slept all Saturday night, was nervous Sunday, worse towards eve, and slept poorly last night. Very hot and humid weather. No pains. Tongue burnt a little to-day. Felt stronger, had the best Sunday he has had and feels less used up after work than any time yet. Reports that small pieces of the tumor are sloughing off. Are like nodules of rubber or gristle. Tumor grows steadily smaller, is reduced in depth one-half, in width one-third, and but little in length.

May 15. Slept only fair last night; napped two hours,

and woke and napped alternately till morning, but had no suffering. Night was the hottest of the season and heat was his only complaint. Now eats anything. Chews meat, but has to assist deglutition owing to lack of mobility of tongue. Salivation last night used two towels. At 10:30 o'clock A. M. soreness in occipital scalp began, got worse as day progressed, till he reached office and treatment relieved. Was the worst he had so far since first attack. Another decolorized nodule separated to-day. Granulations of the tumor gain in appearance of health. Feels better all over, has more energy, appetite good, eats well, except when he has pain. The only pain he has had of late has been the scalp soreness, which appears to be in part related to state of digestion and in part related to the grandular involvement.

May 16. Bright and smiling. Best report yet. His only distress was the occipital distress, which came on at 2 P. M., but was only a fourth as severe as yesterday. Worked hard all day. Neither gland nor tongue gave any trouble and his face has never looked so well before. After seance he spoke in his full natural voice for the first time since the neoplasm affected his articulation.

May 17. Wakeful last night, but no pain. To-day had about one-quarter the occipital soreness of yesterday. Weighed; gain one-half pound. Holds all improvement. Tumor looks redder to-day, and the granulations in front are more pointed. Did not like its appearance so well as of late. Voice also husky and not up to standard. Treatment restored usual sense of well-being and cleared voice.

May 18. Slept all night A1. To-day had some occipital soreness, but no other trouble. Tumor looks more irritable; many of the granulations are getting pointed. Was seen to-day by surgeon who assisted in operation on brother of Mr. J. Expressed no opinion as to final outcome, but as to present results said: "It is remarkable. Would not believe it if I had not seen it and heard so

much corroborative evidence." Four other physicians present had watched the case from the start and confirmed reported gain to date.

May 19. Points of granulations are sloughing off the tumor. Had no pain in tongue, but had occipital soreness all day. Was his only complaint. It irritates and takes away appetite when it is severe. After seance felt better than after any previous treatment. Sensation in the tumor becomes keener.

May 21. Reports a nervous Sunday, a few shooting pains, some one-sided soreness of scalp. No other complaints. At present some rapid change appears to be taking place in the tumor, but whether for better or worse is hard to say. There is no doubt that the tumor is shrinking, but he does not gain any more weight and voice remains same. Is tongue-tied by the mass and attachments under the tongue. Holds his general vigor and works hard every day.

May 23. Good report. No complaints. Eats and sleeps well now and appears to have gotten away from the irritations that began three weeks ago. Says he feels 80 per cent. better than he did five days ago. Tumor has a good color. The point at anterior edge of sulcus has peduculated and is now like a small teat. Face gains in color and vigor. The faint marking across tumor pointed out by Dr. H——— two weeks ago as a line of demarcation is now a plain white line, and he predicts that the front patch, the size of a nickle, will soon be sequestrated. Mr. J———'s general tone has improved so far in proportion as I have abated the pains and the soreness of the scalp, showing that the ravages of cancer are not so much the direct action of the growth as the secondary effects of pains which cut down nutrition by preventing it. The inhibition of appetite and digestion and sleep by the peculiar agony of his pains more nearly accounted for his rapid decline prior to my treatment than the size of the tumor or its direct influence.

May 26. "Better in every way." This has been his best, though busiest, week. Says tumor is now reduced to size it was last August, nine months ago. On night of May 24, he woke up with a hemorrhage from tongue of about two or three tablespoonfuls. Had no pain, no symptoms, and the bleeding appeared to ease the remnant of the occipital soreness which had been getting less and less all the week. Another small piece sloughed off the tumor. Ease in eating and swallowing slowly improves.

May 31. Has been too busy to attend since last date. Had a good Sunday. On the 28th did not leave office till 7:30 P. M. and excited stock market has kept him under great tension. At 5:30 P. M. yesterday began to get fidgetty and an hour later began to have pains. Some soreness returned in the scalp and shooting pains in tongue. All day at intervals of one-quarter hour has had one or two stabs shoot from tumor to back of throat for the first time since static controlled them at the beginning. Tongue very thickly coated, very constipated, two large doses of cathartic failed. Has also sense of fatigue and debility long absent from his reports. Weighed and holds gain. Treatment not only refreshed him in every way to-day, but induced a sense of impending action of the bowels. No drugs prescribed.

June 1. Had to hurry home to W. C., and though his previous stool had been like hard bullets, he had a free mushy evacuation and another in the morning. Day was very hot and his work heavy, but held his own. Tumor burned some all to-day. Sub-maxillary mass is slightly larger, but gives no trouble. Did not sleep very well. When he misses regular treatment he has not appeared to lose any ground. The tumor never starts to grow, but always shows gain.

June 2. Slept finely; woke only once till he was called at 7 A. M. for breakfast; had good stool; tongue less yellow; facial color now good and lips full of red blood; no

cachexia, but looks like a man who had been sick and overworked and was not yet built up. The heat, perspiration and hard work he does may be the reason why he gains no more weight. Had some small burning in tumor and soreness in scalp, but treatment removed as usual.

June 4. Bowels act better; no special pain or complaint; tumor looks smaller; measures one-half original width; has receded three-eighths inch from anterior limit; the deep sulcus is now shallow and small, but two nodules have risen high above the level of inner border near the front. One looks as if getting ready to slough off. Was wakeful last night.

June 5. Weight same as last report. Has been weighed each week on standard Fairbanks' scales. Does not gain more, but holds what he gained at first. Had another discharge of blood, same as on May 26. Slept fairly; enjoys his food; scalp has been less sore; feels decidedly more energy as each week goes by. Bowels act better; the tumor crests up more on the inner border and is getting like a miniature rooster comb. Rapid growth and change is a marked feature of such segments of the tumor as seem to suddenly take on action. An aggravation has has been rare and most of the changes have been for the better. To-day he remarked: "My relief that you give me compares with the best I got from drugs as 100 to 1." Tumor is now very narrow posteriorly. Inclusive length now measures one and an eighth inches, greatest width is nine-sixteenths inch, and the total mass above the floor of the mouth is but a fraction of the tumor on April 11.

June 6. Tumor looks best to-day that I have ever seen it, but he reports poorly. Bad sleep; increased salivation; some oozing of blood; scalp sore; burning in tongue; debility. To-day very hot and humid. The "coxcomb" of the tumor has smoothed down; color good, and whole tumor now looks like healthy granulation tissue except that some portions are paler. In reports of his disturb-

ing symptoms, which are cited here exactly as he gave them at each visit, it should be noted that they are all removed by treatment and remain absent for the balance of the day and only come on gradually during the following afternoon. He does not feel the need of any anodyne or drug of any kind, as what distress he has is mild in degree and easily tolerated.

June 7. Slept fairly, but to-day has had more severe soreness in scalp. This symptom he refers to the submaxillary mass, which is not controlled as well as the tumor, which can be directly treated. It gets soft and after the night in bed it is a mere shot in size, but fills up during the day, and when he reaches office at 4:30 P. M. is size of large marrowfoot pea now. Is not adherent to the skin. Action of bowels now about normal; has had three special treatments only for his late constipation, and seems to require no more.

June 8. Slept fairly; appetite normal; tumor smaller; but from 2 to 4 o'clock this P. M. was quite distressed by sore scalp and burning in tongue.

June 9. Better report. Bowels regular and splendid action. Tongue much cleaner. Had more salivation last night than usual. The crest of tumor now seems higher, but thinner. Is now rapidly shortening. Formerly covered teeth in front and was indented by them. Also covered the rear molar. Now fills only the space of the missing teeth. Sub-maxillary mass is hard and does not now reduce by treatment as formerly. Is also fixed, though not adherent to the skin.

June 12. Weighs same as last report. Is very "tongue-tied" now in his speech and tongue is so much less mobile that he will quit solid food, owing to the difficulty of passing it back over the tongue for deglutition. No pains. Had soreness in scalp. Tumor is fast receding; is now so thin and smooth at the outer margin of the entire tongue that it looks almost as if it had been shaved off with a

knife. The crest at the inner anterior remnant of growth is thinner, higher and appears about to slough off.

June 14. Feels stronger. Has less irritability left from the old effects of cocaine. Averages better. Does not lose any part of his gains when he omits treatment. Reports that he has had some pains in his tongue, but they were entirely different from the cancer pains and felt more like "contractions," "as if something was at work trying to crowd the tumor out." Tumor is now very thin from side to side and very greatly reduced in total mass. Is smooth over most of the surface and has cracked around the base of the crest as if sloughing off. I can lift up part of the crest with the point of the electrode.

June 15. Good report all but sore scalp. Sub-max. mass feels less fixed; is smaller than for the last three weeks and voice is less tongue-tied. Bowels goods. Tumor now but a small fragment of original size, so far as the eye can see. What is under the tongue I do not know. To visiting physicians each week of his treatment has shown a striking change.

June 18. Came in strong and cheerful. Voice nearer normal than at any time save once. Salivation is more watery and less like jelly, though when this symptom is mentioned at all it is trifling compared with the great outpour of the glands prior to my treatment. To-day he reports a little increase. Sub-max. mass now appears to be reducing. Few disturbing symptoms and no complaint. Has spit out a little clotted blood on waking last four mornings. Crest of tumor is highest it has yet been; rises full one-eighth inch clean from surface of tongue and is all there is left of the original neoplasm of the tongue. The side of the tongue now is smooth and red, and looks as if it would soon resume a normal mucous membrane. Bowels costive and repeated special abdominal application.

June 21. Side of tongue is fast paling and taking on normal appearance. Face looks better. Crest of the small

remnant of the growth is very lose and will fall off soon. Salivation less. Scalp some sore. Sub-max. still enlarged but all conditions are improved.

June 25. Very little pain. Lost one pound since last report of weight. Has no complaint. Tongue looks much better to-day than on last visit. Bowels move daily and fine. No coating on tongue of late. Sub-max. mass now remains full size all the time. Does not absorb during night as at first and has assumed a different character.

June 28. Sleep poor. Extreme hot weather very depressing to all. Was tired when he came in. Treatment refreshed finely, as usual. His endurance of work during the unusual heat of this June is remarkable for a man who was sent home to languish a few weeks and die by his employer just before April 11, when he first came to me. This makes his fiftieth treatment to date.

June 29. Same report as last, but slept better.

July 2. Sleeps better. Feels worse to-day. Is depressed and nervous. Salivation smells foul for the first time since treatment corrected fetor. Sub-max. mass is larger and has a new lump beside it the size of a pea and hard. Tumor shows line of demarcation at base of remaining portion, which is the area of a silver dime only. Treatment toned up as usual.

July 3. Went home feeling well and slept well. Has not had any soreness of scalp since I last noted it, June 21. Now keeps very fidgetty and nervous. To-day has had many pains in throat. Has no craving for any drugs.

July 7. Weighed and holds same as last report. Sleeps fairly well; voice is now thicker; sub-maxillary lump is decidedly larger this last week and is now relapsed to about the size it was at his first visit.

July 13. "Been too busy to come for treatment." No loss of any kind since last report. Has got along very well. Sub-max. about same as last visit. Tumor is a little smaller in area, but a little higher in the crest.

July 18. Has been too busy to come, as other employees

are taking vacations. Has held up strength despite hot wave and extra work. No special complaint, except that the sub-maxillary mass is larger and hard and for the last few nights salivation has been increased. Since the second day of July the heat has been severe and he has had but five treatments, when he should have been treated as near daily as possible.

At this date my personal treatment was stopped by my leaving the city on my vacation. In these clinical reports of his condition at each visit nothing has been omitted. All his unfavorable reports and changes have been given fully, my purpose being not to make out a case for static electricity, but to picture the exact career of the patient from my first treatment to the last. It has been difficult to restrain the hopes of the patient and to convince him that even so great palliation does not necessarily mean recovery. So far as the primary neoplasm of the tongue is concerned, all physicians who have seen the case have agreed that the visible appearance and course of the healing process seemed to point to entire resolution by granulation. The barrier of the skin between current action and the erratic grandular involvement has prevented the same kind of treatment and the only practical external methods have not been so efficacious as the direct attack on the tongue. During the remaining hot weather, at work and without my treatment, he will probably lose ground rapidly. Yet he has had about 100 days' respite from his former agony; has been able to work; has averaged a very tolerable state of comfort, and has been brought from the verge of the grave to a state of general health and vigor equal to his state more than a year ago. To this decisive palliation by static electricity there have been no drawbacks whatever. The treatment is always a delight to him and gives physiological relief with no disturbing or secondary reaction.

From the study of cases of lupus and tuberculous lesions of the skin reported treated by X-rays and other

cases by "ultra-violet light," it appears to me that the advantages in favor of direct applications of static electricity are decisive. As a flexible, dosable, controllable, accurate, efficient and practical therapeutic agent the discharge from a Crookes tube cannot be compared with the facile discharge from a static electrode in the hands of a master of technique. Theoretically, it appears to me that the three therapeutic actions are analagous and similar. This being so, I prefer the most convenient means of setting up the action. Nothing that I have read so far of the results of the two alternate measures indicates any superiority to the manifold resources of the static current. On the contrary, they are manifestly and greatly inferior, if published cases are a criterion. Now and then I learn of some physician who timidly cherishes a case of lupus, or chronic ulcer, or tuberculosis of the skin, thinking his good results with such methods of static as he knows how to use are new, original and so unconfirmed that if he published them they would be ridiculed by all true-minded medical skeptics. Yet any one who will turn the latter pages of my "Manual of Static Electricity" will find that the old electricians of the eighteenth century were doing about the same thing, and so has many another isolated experimenter with this agent in modern times. The only startling "novelty" about the matter is that so few of the leading specialists and influential practitioners know that it can be done and done very easily.

I see no reason to doubt that in properly applied static electricity we have our best resource for the palliation or cure (in curable cases) of all lesions for which X-ray and concentrated light action has been recommended, and for which other resources of medicine and surgery lack the powerful impetus to the "innate endeavors of nature to restore the sound state" that is so marked a characteristic of masterful static administrations.

CHAPTER VIII.

A PLUNGE INTO ELECTRO-THERAPEUTICS. A CHAPTER WITH A MORAL.

Crossing the Rubicon.—Progress is Made.—The Wisdom of Experience.—Psychic Electricity.—The Moral.

There are more ways of teaching than through a clinic. Those who early trod the troubled pathway of "picked-up" experience will find in the following narrative reminiscences of their own. Those who but now attempt the A. B. C. of this important branch of medical practice will avoid many pitfalls and save much expense if they profit by the mistakes of Dr. Ohms. It is my purpose to here illustrate the disadvantages under which the average physician labors who has been taught nothing about medical electricity in a medical college and who first buys a battery and then looks around to see what he will do with it. The lesson will come home to many.

CROSSING THE RUBICON.

For the purpose of this truthful and instructive story I shall suppose that a canvasser, or advertisement, or catalogue, or clinical report, or some other effective influence, has aroused an interest in the subject of electricity in the mind of an established physician.* He has perhaps a difficult case on his hands which nothing else seems to benefit, and he is induced to look into the possibilities of an agent he has heard about, but never tried.

*Some years ago.

He has a large medical library and he naturally turns to it for basic facts.

In a dozen text-books on practice, therapeutics and materia medica, aggregating some 12,000 or 15,000 pages, he has the great good fortune to find a score or two of pages which apparently enlighten him as he desires. He reads about anodes and cathodes, labile and stabile applications, Ohms' law, electrotonus, R. D., ions, osmosis, exciting cells, volts and inductions coils, miliamperes, primary and secondary currents, rheotomes and rheophores, and various other text-book technicalities. This is all very interesting, although a trifle indefinite, but further on several diseases are quoted which electricity is said to be "good for," and he concludes to write to a dealer for advice as to the best battery for a general practitioner to buy.

The dealer sends an illustrated price list, which is a veritable mine of information. It offers batteries at assorted rates, from $7.50 to $50.00. It pictures a great variety of electrodes and appliances, some of which have neither existence nor practical use outside of the illustration. The high-priced cabinets are attractive, of course, but the prospective and prudent purchaser reasons very fairly that as he is without experience he had better learn on a cheap battery and buy a better one after he gets more skill. Moreover, he may not like electricity after he tries it and it will be cheaper to throw away a ten-dollar instrument than one worth $100.

Still he prefers a reliable article, and will not be too frugal in regard to price. Let us see what the catalogue offers:

Machine No. 1, price $7, "made to meet a demand for a low-priced battery for domestic use."

This will hardly do, for if the physician encounters one in the hands of a patient he must be equipped to compete with a better article or she will treat herself at home as before.

Battery No. 2 is $12, and is stated to be "a very convenient form of battery for a physician or family use."

This is quite promising, but here is No. 3: "More desirable for a physician, has a large coil, rapid vibrator, gives three variations of the current, is furnished with handles, cords and sponge electrodes, for $20 list, or $15 net cash." This evidently is the one to buy, and it is ordered, C. O. D. The Rubicon is crossed. The mysterious plunge into electricity is taken. The battery arrives. The circular directions for starting it into action are carefully studied, and the doctor is ready for work. The first patient that comes in is a man with lumbago. He is at once stripped to his waist, placed face downward on a table and the sponges, "thoroughly moistened," as per circular, are rubbed up and down his back till he declares he has no more pain. He gets up astonished and the doctor is a proud and happy man.

For a few days his cases seem to run to lumbago, and he treats them with great success. Liniments and plasters become back numbers, and tincture of iodine is simply nowhere. "There is nothing like electricity and a first-class battery!"

The next day brings in a patient with an irritable spine, an irritated and congested uterus and enough symptoms to indicate a dozen drugs. Ah! if he could only treat her with electricity! Perhaps he can! He writes to a gynecologist who knows how, and learns by return mail that he may apply a sedative, rapidly interrupted high-tension current from a long, fine wire coil, say 1,500 yards No. 36 wire, using for the purpose a modified Apostoli's bi-polar vaginal electrode. Hastening to his beautiful new battery to carry out this simple recommendation, he searches in vain for a long, fine wire coil, and the only electrodes he can find in the box are two which are covered with sponge, but apparently not intended for vaginal use.

Can it be that something is lacking in his new outfit?

What is meant by a "high-tension coil," and why doesn't his battery have one?

He lets the matter rest for a time and resorts to the traditional tampon for his patient's relief. He has, however, ordered a small work on electro-therapeutics (1886), and when his old case of chronic endometritis comes in to remind him of her age-long woes, he chuckles gleefully over the surprise in store for her when she finds herself speedily cured by electricity. Out comes the new book, which will tell just how to do it.

But what is all this he reads about chemical galvano-caustic polar action, 100 miliamperes, Apostoli's method, platinum electrode, intra-uterine application? The directions with his elegant solid oak battery say nothing about "Apostoli," and if there is any platinum on his sponge electrodes it must be under the sponge; and at any rate the directions do not disclose how one could be gotten into the uterus. Long and carefully he ponders over his battery before commencing treatment, and though it is clear that the "primary current (mild), binding posts Nos. 1 and 2," must be correct for the galvano-caustic current, yet he is much puzzled about the *miliamperes*.

The directions say "the strength of the current is increased by drawing out the sliding cylinder," but fail to state how far out it must be drawn to equal 100 miliamperes. This is probably an insignificant oversight of the makers, and need not deter a practiced hand from beginning at once on the patient. Moreover, if one of the sponge-covered electrodes won't go inside the uterus, why use it outside, of course. The electricity will go through all the same, and trifles like these mut not prevent the patient from getting cured.

One month later—Case book record: "Electricity is remarkably efficient in lumbago. In a series of three cases treated by me the results were as follows: Cured 100 per cent.; improved, 100 per cent.; unimproved, none. Fails in endometritis. In case faithfully treated weekly for an

entire month no remarked result was obtained beyond the temporary relief of certain symptomatic conditions; not, perhaps, dependent upon the underlying diathesis. Too much should not be claimed for this empirical agent, as it evidently fails in a certain proportion of cases."

The first glamour of medical electricity was plainly wearing off. There could no longer be any doubt but that Erb, Duchenne & Co. were over-sanguine as to its value, and, like many another new-born fad, its proper level was to be settled by time. Being disposed to give it a fair trial, however, he would not yet discard it entirely.

Soon after this date he received in the mail a reprint of an elaborate article on "Metallic Electrolysis," by a well-known and successful authority. It was a revelation to him. A method giving such grand results was too important to neglect. He must certainly get out his battery and take to using it more freely than he had of late. The battery accordingly was carefully dusted and its youth renewed with fresh bichromate of potassium solution, per formula in the "directions."

His enthusiasm was aroused to 104 degrees Fahrenheit by a second perusal of the following statement: "This method involves the use of attackable electrodes—copper, zinc, silver, K. I., etc.—with mild currents and long sittings. Electrolytic cataphoresis has already been applied in a vast variety of conditions, and nothing in modern medicine equals it in possibilities. It offers our best method of combating diseased conditions of all mucous membranes—those of the eye, nose, throat, urethra, vagina and uterus—also hemorrhoids, keloid, conjunctitives, trachoma, acute and chronic; hypertrophic and atrophic rhinitis, ozena, urethritis, endometritis, inflammations of the adnexa, etc. In uterine cases this method is easier and better than Apostoli's and the benefit lasts longer."

In his mind's eye our hero fairly raked his town with a fine tooth comb for cases of the above lesions, and

dreamed he cured them so fast that he fancied himself able to order a horseless road cart for a Christmas present to his wife (intending, of course, to use it himself occasionally in his professional calls).

Electricity was surely a therapeutic magician, and why every doctor did not at once buy and use a first-class electrical battery, with cords, sponge handles and solid oak box, was difficult to see. "These recent aids to science went far to make a professional life worth living," and turned the drudgery of curing urethritis, ozenas and "female weakness" into a pleasant and refreshing pastime. The battery must not be allowed to rust again, and filled with these diverting thoughts the worthy doctor proceeded to overhaul his outfit and make ready for diseases of the mucous membranes.

This time he was determined not to be baffled by anything. If he could not produce cupric electrolysis with his sponge electrodes at the start he would write to New York for further instructions and find out how to do it.

Critical inspection of his apparatus and an hour of experimental work indicated that something was lacking to complete his outfit. The next mail carried an order to New York for one set copper-tip electrodes, eight sizes, price $7.33, per catalogue. They came C. O. D. and were brightly polished, arranged in a row, screwed upon a plate, and seemed to mark a new era in the career of the solid oak battery. They must be tried at once. But how? What would they fit on to? Were all to be used at once, or only a few at a time? At last a brilliant idea presented itself. He would unscrew the sponges from the wooden handles and then screw on two of the copper tips.

He ought to have thought of this before. Eight tips (four pairs) indicated that they were to be used two at a time. To his great amazement an attempt to carry out this idea disclosed the singular fact that the screw threads of the copper tips would not fit the wood handles.

PROGRESS IS MADE.

In our last section we left a promising electro-therapeutist struggling with the technique of metallic electrolysis. His electrical outfit included a recent purchase of eight copper tips, together with his well-known battery described in the catalogue as follows: "Battery No. 3. More desirable for a physician; has a large coil, rapid vibrator; gives three variations of the current; has solid oak case, and is furnished with handles, cords and sponge electrodes, for $20 list." (Discount to the profession 25 per cent.)

He has attempted to use the copper tips by screwing them on the wooden handles, from which, with great and original ingenuity, he has unscrewed and removed the sponges. Owing to a disproportion in size, they do not fit, and he writes a complaint to the makers in New York. By mail a week later he learns that a special handle is required, price $2; and having determined that no obstacles shall stop his scientific employment of the grand therapeutic agent which has been so recently discovered, he orders a pair immediately. When they arrive he prepares to abandon medical prescriptions and topical applications for all forms of catarrhal conditions of mucous membranes, and rely exclusively upon "electrolytic cataphoresis." Cases wait in his reception room, and he gets the battery ready, attaches a copper electrode to each new handle and a handle to each cord.

Now let us again attack our old case of endometritis. One pole must be "intra-uterine," the book says; and, being an expert gynecologist, there is no trouble in placing it in that situation. The other pole, of course, may be held in the hand. Very simple. Certainly electricity is beautiful when one has all the requisite appliances! Now the patient is all ready and the current may be turned on!

From a feeling of sympathy for all parties concerned,

I draw the curtain upon what happened when that energetic faradic current was turned on.

The patient had been an old family friend. She had before tried many things the doctor had recommended; but it is her present view, in which her physician entirely coincides, that "cupric electrolysis" is not suited in her case. She does not mean to disparage the remedy, but is inclined to regard it as a little worse than the disease. Between the two her choice is endometritis every time.

We would give a good deal to hear the doctor's private opinion about her "foolish hysterics" just when he had everything so thoroughly prepared to treat her case—but Dr. Ohms is a discreet practitioner, and he next gave her a sugar-coated placebo.

The doctor was naturally a student. In employing a new remedy he made it a point to read up the printed matter very fully. He pursued the same custom now. The more he read circulars and catalogues about medical electricity the more favorably it impressed him.

It appeared to be even more efficacious than he had supposed. About this time he also made an astonishing discovery, viz., that his "three current" battery was one kind of electricity only, instead of three varieties, and did not supply any galvanism at all. Professional enterprise demanded that he should have every modern aid to medical science, and he recognized that the future called for liberal expenditure rather than parsimonious old fogyism.

After some correspondence the makers allowed him $5 for his second-hand battery and sold him a 16-cell combined galvanic and faradic apparatus for $38. As the catalogue states: "This combination enables the physician to use either form of current at will, and in this respect is especially desirable for office practice for the specialist."

This is what his enlarged experience told him that he required, and with it he foresaw that he would naturally

drift into becoming an electrical specialist later on. It weighed four times as much as his first investment, and on his office table its appearance was exceedingly gratifying. He now felt prepared for difficult cases of all sorts.

One was soon found—an elderly lady—chronic sciatica of thirty years' standing; but having two batteries combined instead of one, he was at a loss to know which of the two to use. Here the doctor's studious turn of mind came to his rescue, and he secured the following guiding facts out of his library:

1. "Duchenne's treatment consisted in severe faradization of the painful area, limiting the action to the cutaneous surface. After the application of the dry brush the patient is astonished to find all pain of the sciatica gone, and though he tries to provoke its return, it does not do so. One, four, six or eight treatments will cure."

2. "Von Ziemssen says that in the galvanic treatment of neuralgic pains large electrodes should be used; and it has even been proposed to use electrodes large enough, if possible, to cover the whole of the affected area at once."

3. "Steavenson says that this painful affection is particularly suited to treatment by the electric bath. A course of twelve baths usually suffices to affect a cure. The ascending direction of the current should be preferred."

4. Hutchinson states: "Galvanism will relieve almost every case. Use a descending current. Faradism is to be strongly deprecated here. In ordinary case, place foot in basin of water, with negative pole. Press a small carbon wash leather covered button firmly over nerve's exit from ischiatic notch to localize the current in the nerve. Increase dose to all patient can bear. Apply thirty minutes daily. Three weeks will cure."

5. "Dr. A——— advocated the treatment of sciatica by the strong galvanic current."

6. "Dr. B——— was in the habit of using the faradic current in the treatment of sciatica."

7. "Dr. C——— begins with very small currents of galvanism, say one and a half miliamperes or less, cautiously applied for one minute. Gradually increase to three mil. for three minutes, when improvement takes place. He ignored the matter of current *direction*, and believed that the idea that it was of any importance was worthy only of the Dark Ages."

8. "Dr. D——— advised the rest cure, followed by electro-cautery applications to the painful points, and later electrical massage."

9. "Dr. E——— pounded the course of the nerve with long, thick percussive sparks. A few treatments gave permanent relief. This surpassed all other methods and gave quicker and better results."

Dr. Ohms thoughtfully read over these valuable rules for the electrical treatment of his sciatica patient. They were somewhat more prolific than he had expected to find. He examined his apparatus. He had besides the new "combination," the same cords, wood handles and sponge electrodes that he had before, and the set of copper tips purchased when he attempted to perform cupric electrolysis with his original faradic battery. How should he proceed? Common-sense principles helped him out of his dilemma, and he adopted a process of eliminating the impossible.

For instance, in rule No. 1, he had no "dry brush," and did not know what one was. Hence, Mrs. B——— was spared the infliction of Duchenne's remedy. In No. 2 he had no electrode large enough to cover Mrs. B———'s whole limb, hence Bon Ziemssen's plan was out of the question. No. 3 spoke of an electric bath. He had no such an affair; and, moreover, the idea of his bathing a female patient was preposterous. No. 4 came nearer the mark. He could provide the foot basin of water, and possibly one of the sponge electrodes might serve in

place of the missing carbon button covered with leather; but he did not fail to note the direct conflict between No. 3 and No. 4 in regard to the direction of the current. He was too cautious now to risk an ascending current when a *vice versa* was required, and he had no way to prove whether Steavenson or Hutchinson was right. Observing the objection to faradism recorded in No. 4, he was glad he had not used it as Duchenne advised.

No. 5 was simple, straightforward and much to the point. He liked it on these accounts, and laid it aside for future reference. No. 6 rather astonished Dr. Ohms and caused him to lose confidence in the man who recommended faradism for sciatica. No. 7 looked safe, and at once appealed to his recently-developed bump of caution. The brief time required (one minute) would be a great convenience in his office practice, and he noted with satisfaction that here was an author who helped him out of his quandary about current direction. If Dr. C——— ignored it, so would he.

Arriving at Nos. 8 and 9, he puzzled over them at some length. He knew just what a cautery application was, but he sought vainly in the directions accompanying his 16-cell galvanic and faradic combination for any hint as to how to produce it with sponge electrodes. Several experiments satisfied him that he did not quite understand how to do it. "Rest" and "massage" were simple enough, but he did not like to adopt No. 8 and omit the cautery. It would seem like the play of "Hamlet" with Hamlet left out.

No. 9 excited his curiosity. It "surpassed" all other methods, and in this respect he felt that Mrs. B——— would be pleased; but what were "long, thick, powerful, percussive sparks," and how could he apply them with his new battery? Should be attach the sponge electrodes to the faradic or the galvanic side of the combination? He had Mrs. B——— wait while he made a private trial of both, but time was too short to work out the problem

fully and he decided to begin with No. 7 and if it failed to try No. 5.

The following day's mail contained this letter from Dr. Ohms to the manufacturers from whom he had purchased the "combination":

Messrs. Coil and Blank:

GENTLEMEN—I recently ordered from your firm a 16-cell combination battery. On attempting to treat a case of sciatica with it I fail to find any directions about the miliamperes. Please inform me how many each cell contains, and what a miliampere amounts to. I endeavored (following a leading authority) to apply one and one-half miliamperes for one minute, but, although I applied five cells at first, and finally 10, and afterwards the whole 16, I was unable to start the vibrator into action. The battery is evidently out of order. Please send me full instructions at once, and oblige. Yours very truly,

DR. OHMS.

While waiting a reply he chanced upon an article in a medical journal, stating that no therapeutic application of the constant current should be made without the presence in the circuit of a reliable miliampere-meter.

FURTHER PROGRESS.

We left Dr. Ohms on the verge of making the acquaintance of a meter. As his experience enlarged he added to his electrical information gradually, and his latest discovery referred to the necessity of some device to comply with the new custom of measuring the galvanic dose. Before the firm he had written to could respond, he sent them an order for a standard instrument (price per catalogue $40), but almost immediately afterwards he encountered these remarks by Dr. X———: "I look upon the galvano-meter in practical electro-therapeutics merely as a means of determining the strength of the battery at

the moment when the connection with the galvanometer is made, but by no means do I believe the galvanometer absolutely necessary to indicate the exact number of miliamperes which it is essential for us to administer in a given case, or which the patient can endure. The real therapeutic limit of the current is, after all, a decided sensation of pain complained of by the patient. When this point is reached the current of electricity is strong enough, no matter what the miliampere-meter may indicate." Dr. Ohms hastily countermanded his order! He was perfectly willing to buy everything that was *necessary* to complete his outfit and to make it in every way worthy of the office of an electro-specialist, but $40 luxuries were quite another thing.

The following letter evidently crossed his communication in the mail, and is self-explanatory:

DEAR DOCTOR—In reply to your esteemed favor we beg to say that cells and miliamperes are not convertible terms at all times. Your 16 cells would produce an amperage according to the resistance, but will not make the vibrator on the faradic side of your battery hum. There is no vibrator to the galvanic side of our combined batteries, and we advise you to read over the directions carefully when using same. In the technique of galvanotherapeutics we regard a milampere-meter as a *sine qua non*. Its use has lifted galvanism out of empiricism and placed it squarely upon a scientific basis. You are correct in attaching to it the very highest importance, as in the opinion of the best authorities no electrician of good standing can afford to be without one. Thanking you for your valued order, which we forward by express, and assuring you of the superior workmanship of all our goods, we remain, very truly yours,

COIL & BLANK,
Dealers in Electro-Medical Apparatus.

As this made the meter appear to be inevitable, Dr.

Ohm resigned himself and prepared to meet the C. O. D. draft for $40. When he reflected that it would preserve him from all future "empiricism," his satisfaction somewhat increased, for as an exponent of scientific medicine his objection to empirical procedure was deep-rooted. He also perceived that it would at once place him indisputably in the ranks of electricians in good professional standing. The meter soon arrived.

The cords and sponge electrodes were got out for a little private exhibition of the meter to his family when the doctor began to experience sudden qualms of uncertainty about where to put it and what to do with it. He read all the circulars and directions he had so far received without finding any light on the subject. It seemed to him that nearly all medical books were written to conceal information.

However, his wits led him to consult the makers, and at the end of a week he had it connected in series properly, with the aid of an extra piece of copper wire. His delight now knew no bounds. Over and over again he watched the needle jump as he touched the well-moistened sponge electrodes together, and as this amused his tireless little boy he soon had the battery run down to half its original E. M. F.

As we have seen, Dr. Ohms was both studious and thorough, and it naturally seemed to him that if he expected to rise in the ranks of electrical specialists he must, of course, ground himself thoroughly in the basic principles of electro-diagnosis. All the books spoke at some length of electro-diagnosis, and he concluded that it lay at the foundation of all skill in the use of electricity and was something needed constantly in his office work.

He got at it in this way: He took out his physiology and attacked the chapter on "Degeneration and Regeneration of Nerves." He took Pflugers' "Law of Contraction" and memorized:

C. C. C.	C. O. C.
A. C. C.	A. O. C.
A. O. C	A. C. C.
C. O. C.	C. C. C.

from end to end and from before backwards. He read up intra-polar and extra-polar electrotonus, negative variation, weak, moderate and strong currents; and he pasted in the cover of the battery box the following memoranda:

"Anode—Copper positive pole, action sedative. Cathode—zinc negative pole, action exciting. 1. Weak—No anodal contraction caused. 2. Medium—Anodal contraction when current ceases. 3. Strong—Destroy conduction during current."

He also noted that R. D. means "reaction of degeneration," and was ready to meet the enemy and diagnose him *secundum artum.*

Just at this point his old friend with endometritis came in to obtain some further stock of the placebo he had precribed since his disaster in attempting to perform intra-uterine cupric electrolysis with his original faradic battery. How fortunate!

"My dear Mrs. B———," he exclaimed. "I was just thinking of you. I have had your case in my mind for some time with a view to discover some way to give you a complete cure. Now a new electrode called the 'bi-polar' has just been introduced to leading electro-specialists, and by its use the most wonderful results are said to be obtained. I shall immediately procure one and put you upon a course of sedative treatment." Mrs. B——— expressed her very great pleasure at the hope of cure, and Dr. Ohms ordered the electrode.

It struck him as being a bit careless that the dealers forgot to send the complete *pair.* Such mistakes caused delay, and were exceedingly annoying, and to receive only one electrode when he especially ordered *bi*-polar was aggravating. "Bi" meant two certainly, and two does

not mean one! Later the peculiar nature of the bi-polar electrode was explained to him and he grasped the idea successfully.

"Now, Mrs. B———," said Dr. Ohms, with the calm confidence born out of library researches, "this electrode produces a *remarkable sedative effect.* What your womb needs is *sedation.* It has been inflamed for so many years that we must soothe and quiet it. You see you are not required to remove any clothing. Just recline as usual upon the table, place your feet in the stirrups, whilst I simply insert the electrode and turn on the current. All ready? There we are! How does that feel?"

Mrs. B——— did not feel anything. The doctor cautiously drew out the sliding cylinder and increased the strength of the current. She still felt nothing. He had not discovered the difference between cutaneous applications and the enormous tolerance of the vaginal mucous membrane, and he was perplexed.

Bound to persevere, however, he changed the cords to binding posts 2 and 3, which gave the "strong current" (per directions), and he drew the cylinder out and put it on the table.

Mrs. B——— now felt sensations, but they were far from soothing. Every now and then the current gave a jump, after the fashion of such faradic affairs as this growing electro-therapeutist possessed. Its vibrator was crude and uneven, and its solitary coil contained probably 200 feet of coarse wire. His glowing fancy pictured it as something superb, for it was a "combined galvanic and faradic battery"; its solid oak box stood 12 1-2x13 1-2x11 inches, it weighed fully 30 pounds, and he paid $38 for it in New York.

But something seemed to be wrong with the new electrode! Mrs. B——— said it was "hurting her." What could the matter be? "What are you doing?"

Now the new-fangled electrode had been bought with the distinct understanding that it produced a high ten-

sion *sedative* effect, that it would relieve the pain of pelvic inflammation and establish a local anæthesia. Dr. Ohms was seated by his office pride, wrapped in revery and musing upon his expanding knowledge of electro-therapeutics. Suddenly a yell like a Comanche war-whoop broke upon his ear. "Doctor," shrieked Mrs. B———, "the thingumbob is slipping out!"

Howl after howl of suppressed but piercing agony followed this exclamation, and the doctor stood rooted to the spot. No so Mrs. B———. Grabbing him desperately by the only arm she could reach, she cried: "Pull it out, oh pull it out; stop the battery—quick, quick, it's killing me!"

When the excitement was over, and calm had settled upon the office, Mrs. B——— and the doctor had a talk. "Doctor," said she, "that sedative electrode is too stimulating for my quiet nature. I have tried cupric electrolysis. I have tried this here fancy bi-polar and I—have tried endometritis. I think that with your permission, I will stick to the endometritis."

Two weeks after this startling episode a reprint of an article on the "Faradic Current in Gynecology" was forwarded to Dr. Ohms by its author. In glancing through it his eye fell upon this passage of peculiar interest: "The internal os and tissues at the vulva are very sensitive to the faradic current."

No woman who has passed through the ordeal of childbirth need be told what it is to have a bi-polar electrode slip out of position while the current is on. It is a catastrophe that should never happen, and when Dr. Ohms administers this form of treatment at the present time he devotes himself to keeping the electrode where it belongs.

Let us now go back to the study of electro-diagnosis. As day after day went by the doctor kept on the lookout for clinical material on which to put his studies into practice. In most of his cases he seemed to have no need

to make the diagnosis by electricity, as he readily did in the usual way. Lumbago, sciatica, measles, rheumatism and grip, all these and more in his daily practice he knew at sight without searching for R. D. by electrical reactions.

However, he wished to obtain some practical experience in the technique, so he concluded to call in his coachman and demonstrate the method on him.

For this purpose he laid the man at full length on his operating table, exposed leading groups of muscles and moistened his sponge electrodes. With his eye fixed on Pflugers' law and his memorandum pasted in the cover of the box he applied one electrode to the sternum (per directions), while with the other he prepared to test single and various groups of muscle. Time forbids a full account of the difficulties that arose, one after the other, to perplex this investigator of the reaction of degeneration in the muscular fibres of this brawny Jehu. Our purpose is served when we report that this series of original experiments led the doctor to the disappointing discovery that his battery possessed neither slow rheotome nor single contact key, of which the catalogue speaks in the following terms: "This is used for single muscles and groups of muscles, a great help in diagnosis!"

Clearly, if he expected to do anything in this line of work he would be obliged to make some further additions to his apparatus.

THE WISDOM OF EXPERIENCE.

"There is a tide in the affairs of men which, taken at the flood, leads on" to experience! When Dr. Ohms was confronted by the problem of perfecting himself in electro-diagnosis without a slow vibrator and no "single contact key" he stood for the moment at the parting of the ways. There were two courses open to him. He could go on spending money to increase his outfit, or he could stop.

In the latter case he foresaw that he would never be-

come a finished electrician, and others would pass him in the race of progress. His practice was already increasing. His fame was spreading in his community. His battery made quite an impression upon his office patients, and when he took it out to treat a bedside case he was observed by all observers.

Mrs. B——— and others were beginning to tell about the wonderful things electricity had done for them, and he felt that it would be a mistake to stop. Yet, should he plunge deeper? If so, how? His scientific apparatus had accumulated until he now possessed the following electrical appliances: One 16-cell combination galvanic and faradic battery; one pair of cords, handles and sponge electrodes; one set of copper electrodes with special handles; one miliampere-meter and one bi-polar electrode.

Reviewing these again with increasing professional pride, he recovered some of the confidence he had lost when he sought in vain for the "slow vibrator," and concluded that after all he pretty nearly covered the ground. If he found in time that he really needed a few extra things he would buy them.

An epidemic of tonsilitis shortly prevailed in his neighborhood, and among current medical literature on the subject the following by the merest accident came under his eye: "Treatment of Acute Tonsilitis with the Electro-Cautery."

"Dr. K———, at the State Medical Society, cited several cases. No. 1. Mr. G———, commercial traveler. Both tonsils very much swollen. Was subject to similar attacks. Cauterized each tonsil three or four times. Pain disappeared in two hours. No recurrence.

No. 2. Mrs. L———. Severe attack, each tonsil was punctured three or four times. Pain ceased in two hours.

"No. 3. Miss W———. Pierced each tonsil four or five times with the galvano-cautery. Pain stopped at once. The doctor employed a 'cherry red' heat. He car-

ried the curved electrode from one-half to two-thirds of an inch into the crypts."

On reading this Dr. Ohms was convinced that he must keep abreast of the times. He at once went to his desk and wrote Messrs. Coil & Blank, dealers:

"GENTLEMEN—Please send me by return post a curved electrode. Also please inform me how to do electro-cautery work with your 16-cell galvanic and faradic combination battery which I purchased recently. An early reply will oblige, etc."

He bought a little alcohol lamp, such as jewelers use, to heat the electrode cherry red, and while waiting instructions turned his enthusiasm in things electrical again to gynecology, neuralgia, paralysis, rheumatism, etc.

A long article in the medical column of a New York daily paper on "The Removal of Superfluous Hairs by Electricity" also fascinated him, and he determined to acquire the technique later on.

He presently heard from the manufacturers in reply to his letter about cautery work:

"DEAR DOCTOR—We can furnish your our improved electro-cautery apparatus for from $35 to $60. This battery is intended for eye, ear, nose, throat and all general cautery work, and is capable of heating the largest electrodes or a loop of any required size. Please state what 'curved electrode' you wish, as we have various forms both for genito-urinary, laryngeal and other work. If you are in need of curved sounds we would advise you to buy an entire set. Thanking you for your esteemed order, which we will forward promptly on receipt of your reply, we remain, etc., yours truly,

"COIL & BLANK."

Indeed! $35 to $60. An entire new battery needed!

What could this mean. When he first ordered his original $15 faradic battery he read in some paper by a prominent author that fully 80 per cent. of all cases were treated by faradism. When he afterwards purchased the combination, he supposed, of course, that the galvanic side of the apparatus was for the purpose of treating the remaining 20 per cent.; and now he was calmly informed that he must buy an additional affair which he knew nothing whatever about and never dreamed existed!

His wife said, however, that it would be too bad to have to tell people that he could not treat their tonsilitis because he had not known about the right kind of battey, and as it was the only thing he lacked to make him a complete electro-specialist, she thought he had better buy it. Her sage advice prevailed, and it was ordered.

PSYCHIC ELECTRICITY.

Six months later all seemed to be going exceedingly well. Dr. Ohms' plunge into electro-therapeutics appeared to have reached firm bottom and he stood on secure ground as a specialist with the fullest possible electrical equipment. High-grade scientific apparatus was reaping its due reward when his composure was thoughtlessly disturbed by a gossiping colleague, who had been broadened by travel among the leading Eastern clinics. He called upon Dr. Ohms and was shown with pride the up-to-date collection of electrical treasures.

Strange to say, they did not impress the visitor as evidences of progress. On the contrary, he briskly said: "Why, Dr. Ohms, you are away off. These box batteries of yours are mere toys. What you want is a static machine."

"A static machine! What is that?" inquired Dr. Ohms.

"It is," said his traveled friend, "a most impressive apparatus. It acts largely through the *psychic*, and will make a great moral impression on your patients."

This was an interesting revelation. Never before had

Dr. Ohms heard of a therapeutic agent which possessed the advantage of moral impressiveness, and he wrote to the makers for terms and cost. Once started on the quest of cost he learned that the static machine was really the only true and original instrument in medical electricity. And, although he wondered how he came to be so misled as to the solid oak battery and the "combination," yet he determined to sacrifice his investment in them rather than continue to employ such erroneous devices. His wife agreed that a machine that could act through the psychic must be superior to the combination, and perhaps was even better than physic in some ways, as so many people had become tired of taking medicine. He was also pleased to read the statement of a high authority that the "facility" with which this machine could be applied was its seductive weakness; in fact, a fly in the amber of its otherwise considerable merit; for he would really enjoy a fault of that kind after his former experiences with bi-polar sedation and the cautery. In this narrative the curtain has not been lifted from Dr. Ohms' initial efforts with the latter purchase, for there are some professional secrets that should be guarded from rude gaze. When a cautery starts to burn it does not select its own field of action, nor impose its own limtations on the dose. There are painful reasons for not discussing here this part of Dr. Ohms' development of the laws of electrical science.

To resume: A combination of psychic influence and fatal facility did not impress the Ohms family as a drawback, and a static machine was accordingly ordered as soon as Mrs. Ohms could write the letter; for, being now a busy physician since the fame of his electrical success had spread, he was obliged to farm out his increasing correspondence to his wife. It was agreed that this was better than hiring a typewriter.

The machine was feverishly awaited, and it came shortly. Dr. Ohms had not realized how big it was until he

helped to unload it and carry it into the office. Then he knew that it was surely destined to be impressive.

It was soon set up according to directions, and he admired it greatly. Neighbors called and admired it. Dr. Ohms looked it over thoroughly. The more he looked at it the more his admiration grew. His colleagues who had never seen a battery as large as a piano would now be completely routed. The idea of certainly being the leading practitioner in the county—not merely the town, but the whole county—fascinated the senses. It was a luxury to dream over, and he retired the night after the arrival of the apparatus with visions of greater conquests than the solid oak battery in its early miniature splendor had ever been able to excite.

The next day Dr. Ohms changed the furniture around to make room for his purchase, and packed away all the now obviously obsolete dynamic batteries. Never more would he be deceived into using them. The solid oak, the combination and the cautery all went to the attic, for it was now clear that an electric current with no moral influence was out of place in a scientific physician's office.

Dr. Ohms sat on the platform and viewed the impressiveness of his static machine with satisfaction. He put his wife on the platform, and she was so pleased that she brought in the cook, who had threatened to leave, and pointed out the advantage of living with a small family, where, in case of sickness, she could be cured through the *psychic*, without having to take any medicine. She said she would think it over.

The simplicity of treatment began to fascinate Dr. Ohms. No more wet sponges. No more delusive bipolar electrodes. No more perplexities about electrolysis. "No, Mrs. B. All you have to do is simply to get upon the electric platform and sit still for a certain number of minutes. It acts by suggestion and through your psychic and clothes both, so that the conservation of

modesty is most perfect. It is the only apparatus that eradicates disease by moral impression, and the most eminent neurologists declare that it acts only on your surface, hence you need have no fear of being in any way distressed."

After treatment Mrs. B. said that she had not been hurt at all, and that the idea of being cured through her psychic seemed more agreeable than the sedative electrode had been on a former historic occasion.

It was so rapidly noised abroad that Dr. Ohms had invented the newest, largest and best electric battery in the world, and had it made to order especially for himself, the only one of the kind in existence, Dr. Ohms being the first to discover and originate this remarkable apparatus, that his traveled friend, Dr. Volt, dropped in to compliment himself on having induced the doctor to buy it. Dr. Ohms was in the midst of a seance. The patient sat contentedly in the chair on the platform, about two feet from the machine, enjoying a bath of suggestion and moral influence. Dr. Ohms was busy at his desk. The plates of the machine were motionless. The clock marked eleven minutes and the seance was done. Dr. Ohms understood that ten minutes was the strict Parisian length of a static seance, but for good measure he had so far allowed eleven, and his patients gave no evidence of being overdosed.

"But," said Dr. Volt, "where is your charge?" "Why don't you use the current?"

"Current?" "Charge!"

"Yes; it's the current of the machine that you want to use. I will show you."

And he connected a pair of Leyden jars, set the plates in action, turned the charger, and quickly had going a volley of 12-inch sparks. Sure enough, it was much more impressive than the machine alone. Strange that Dr. Ohms had not discovered it before. "But how will I

know when it is charged?" he asked, as he drew near enough for his friend to hear him through the noise.

A little instruction overcame this difficulty, and during the next week the impressive sound of the long Leyden jar sparks was added to the intrinsic impressiveness of the machine with every patient that was treated. Mrs. Ohms said she feared that some patients might be a little too much impressed, and might not come back; and the sparks were just a little monotonous for both her and the cook when they were kept up during the entire office hours. Still, she was getting used to them, and would not complain for herself if the cook stayed. Dr. Ohms, of course, put science before any mere domestic considerations, and stood by his duty to his patients. Not even if his wife had to do the cooking, would he reduce the dosage of static impressiveness to a single sufferer.

Could it be that the physiological effects were too active? Was the entire town being made immune to future disease? When his clientele dropped to three charity patients, on whom he was perfecting a series of clinical observations for report at length in a leading medical journal, his wife suggested that he go back to his original dose, and not try to cure people too much at one time. The family must live, and if nobody was left sick in the town they would have to move.

The Ohms family did not move, and when Dr. Volt was next in the neighborhood he found the fame of the static machine on a new and sound basis.

"Yes," explained Dr. Ohms, "I know all about static electricity now. I happened to be in the city, and met the great authority, Professor Finewire. He said if I had a half hour to spare he would take me to his office and show me all about it. He did so, and since then I have entirely abandoned the psychic use of the machine without the current. It is very simple. There is practically nothing to learn. I can, of course, give sparks; the professor showed me, but my best patients do not like them

and they disturb the moral effect. The best plan is to connect the umbrella electrode over the head and administer a tonic treatment. I have just learned of a young female, aged 26, who fell at the age of 15, injuring the spine in the lower lumbar vertebræ, where she still has pain and tenderness on pressure, and who is being treated with the umbrella by one of the brightest neurologists in New York, with great results. I shall use no other method myself on the majority of my cases."

Thus Dr. Ohms' skill waxed with his experience, and his practice grew, but a little cloud appeared on the horizon. An enthusiastic patient was eager to induce a friend of hers to come to Dr. Ohms for treatment, which had done her so much good. The old lady felt bound by professional ethics to first consult her distinguished family physician, one of the leading members of the faculty of a great medical college, a learned author, a great specialist and a most genial gentleman. "Sir!" said he to the son who called for advice as to the advantage of static electricity for his mother, "Sir, if your mother wishes to amuse herself, I do not suppose it will hurt her, but she might as well take so much cinnamon water."

When Dr. Ohms heard of this he made a careful series of observations on the comparative effects of static electricity and cinnamon water, and was convinced that a thorough investigation would demonstrate an error on the part of Professor L———. Of course, so renowned an authority would not deliver an opinion without first having fully investigated static electricity, as well as cinnamon water, which his students knew to be one of his favorite prescriptions; but to Dr. Ohms there did not appear to be an exact similarity of action.

Soon a case of neuritis remarked to Dr. Ohms that she was going to bring a friend of hers, who was troubled the same way. Later, it turned out that the eminent nerve specialist, Dr. ———, one of the greatest alienists and writers of the age, had told her friend that her neu-

ritis was not the right kind for electricity. "If it had been a neuritic neuritis, then he would have sent her himself to Dr. Ohms, but being a rheumatic neuritis it was out of the question for her to venture upon any other treatment than that which he was now giving her."

The next day Dr. Ohms received a visit from a neurasthenic lady, who had heard of his wonderful results and wanted to inquire about treatment. She liked the idea herself after she saw the superbly impressive apparatus, and only wanted the assurance of her favorite gynecologist that it was all right. She went to get it, and this is what she got: "Why, you are a bundle of electricity already; you don't want any more."

With her indications fairly clamoring for the great sedative-tonic action of psychic influence and moral impressiveness, she was thus doomed to a life of perpetual invalidism by the President of the County Medical Society, to which Dr. Ohms himself belonged.

The doctor got out his code of medical ethics and carefully perused it to see what warrant his colleague had for robbing him of patients without knowing how he was going to treat them. Had he been a medical merchant selling a single patent remedy with but one action, he could not expect a person to buy unless the medicine fitted her, but Dr. Ohms was a regularly graduated physician, in full standing, and prepared to diagnose any case and prescribe any form of treatment that any other physician could prescribe. The more he pondered on this phase of medical ethics, the more he failed to find any warrant for it in the code book. It occurred to him that his edition might be old, and he wrote to the Academy of Medicine for the latest revision.

Meanwhile, something very curious happened to Dr. Ohms' static machine. The current went out of it as completely as if it had never been in, and, furthermore, it staid out. The season had changed. Summer suddenly was at hand, and Dr. Ohms was in the midst of his first

experience with the depression of humidity and heat. The moral influence of the machine seemed to have gone on strike. Its old-time impressiveness lacked the snap and vigor of true therapeutic efficiency. Through the psychic there was an air of indecision. Patients who came for their usual dose of suggestion had to be told that it was not in its accustomed working order.

Yet the machine looked exactly the same as before. At the end of one day it had lost $16. The next day it lost $21 more. Here was food for thought. He wrote to the makers and followed their directions to the letter, but his daily quota of loss continued till it mounted above $500. The weather then changed, and once more the clouds lifted. The blockade was broken. Patients were glad to be favorably impressed again, and they suggested the news to others, so that during the dry, cool spell Dr. Ohms forgot disaster and took in more than his expenses.

But "dog days" were at hand. Again the machine failed to hold its charge. Mrs. Ohms took a pencil and figured up a total loss to date of x patients per day, at y dollars per visit, for znq days. It amounted to $867. And this was only the first season. In ten years it would be $8,670. In twenty years the static machine would lose them $17,340. It was a rather jarring proposition. "I have been thinking, doctor," said Mrs. Ohms, "that if you could go somewhere and learn how to run the machine, so that it would not lose its psychic effect in summer time, it might be economical in the end. Even if it cost you as much as a hundred dollars, we would save $17,240 in twenty years, and that seems worth saving."

"No," replied Dr. Ohms, "there is really nothing to learn about static electricity. A course of instruction would cost too much and would do no good. Electricity is as yet in its infancy, and no one knows anything about it, so what is the use of trying to get any instruction?"

With the usual vicissitudes, familiar to all novices,

the Ohms machine jogged along till winter. Space forbids an exact repetition of daily events in the doctor's office while his season of discontent lasted. When current in full tide was again turned on by nature's kindness the family rejoiced.

And then happened the most startling episode in Dr. Ohms' career. It is an episode which will tax the credulity of readers as trenching on the improbable too palpably, but the historian records it as a fact. I express no personal opinion as to its truth; no electro-therapeutist confirms it; yet here is the story:

Mrs. Robert J. Jones, of No. 3254 Watts street, was for years the victim of a complication of disorders. She had tried everything. No one understood her case. But for her wonderful constitution she must have died long ago. Suffering a relapse, she now sought advice from the great diagnostician and consultant, the celebrated Dr. ———, whom everybody knows stands at the head of his profession in ——— city. The examination was concluded with the infallible celerity of the great diagnostician and $25 fee paid, and after Mrs. Jones had taken the prescription of Pil., Quinia sulph. grs. 2, three times a day, as directed, she turned to the eminent specialist with a sudden thought and asked: "Doctor, do you think electricity would do me any good?"

The remainder of the story is told by Mrs. Ohms. Says this narrator: "The patient in question, Mrs. Robert J. Jones, called at my husband's office about noon on the ninth day of December. She explained her condition, and stated that she had been referred to him for electrical treatment by the world-renowned consultant, Dr. ———. This excited my husband's suspicions, and he resolved to keep his eye on the hat rack as she went out; but first he questioned her. 'You state, madam, that you were actually referred to electricity by Dr. ———.' 'What did he say to you?'

"Now, this was Mrs. Jones' reply:

"I asked Dr. ——— if he thought electricity would do me any good, and he said: 'Madame, electricity is entirely out of my department of medical practice. I have made no adequate study of electro-physiology and therapeutics. I never express an opinion or venture advice about a remedy as to which I am uninformed. I can, however, send you to a reliable physician who is a competent specialist in the uses of electric currents, and you may safely be guided by what he tells you. If the remedy is not indicated in your case he will so inform you. I refer you to Dr. Ohms, of Ampere street.'

"In *falling*, my husband's head struck the left-hand prime conductor of the machine, crushed it through the glass side of the case, and added traumatism to the severe mental shock. No attempts to revive him have been completely successful as yet. In his lucid moments he turns in bed to his trained nurse and imagines that he is treating Mrs. Jones with a new method of static electricity, originated by the celebrated consultant, Dr. ———. We trust that a few warm, sunny days, when we can get him out for a ride in the park, will restore his mind to its normal state, but it was a great shock, and no doubt full recovery will take time."

THE MORAL.

Many years went by. It is not my purpose to relate the entire history of experiments, expenses and experience that developed Dr. Ohms at last into a practical electro-therapeutist. It was a slow process. In his old age a medical student asked him how he could learn to use electricity in his practice. This was the substance of Dr. Ohms' advice: "First make yourself a skilled physician; then study the physics, physiology, mechanics and chemistry of medical electricity; then seek practical instruction in the technique of applying its general principles to the treatment of patients, and finally buy your

outfit. Get experience and knowledge first, and buy last. Don't do as I did, and buy first.

"Before I knew a rheostat from a megohm, and was absolutely ignorant of the difference between a galvanic and faradic current, I plunged headlong into what I thought was electro-therapeutics, but which was simply *electro-foolishness.* Don't do anything like this. Don't waste your time and money, but begin in a sensible way.

"Now," continued the doctor, "when I bought my first battery I paid $15 for it. My ambition soon outgrew such a small affair, and I invested in a 'combination' for $38. I measured its merit by the cost and size, and supposed it was two and one-half times better than No. 1. It took me a year to find out my mistake. The galvanic side lacked meter, interrupter, rheostat and sufficient E. M. F. The faradic side lacked *everything.* It was not a therapeutic apparatus at all, and deserved only to be skillfully poised on the threshold of my backyard and kicked into my ash heap. I tried to supply deficiencies by ordering extras, but my knowledge was too limited to select properly, and the first collection I made was for the most part obsolete and worthless. My economy in working out my own experience to save the price of proper instruction delayed me ten years in acquiring skill and lost me the fees of enough patients to buy the best house and lot in town. When I bought a static machine I supposed that all I had to do was to buy it, and the machine would do the rest. But there is no kodak button about an electrical apparatus of any kind. It is only what you know how to make it, and I made very little of mine for a long time. 'What is there to learn about it?'

"There is about the same 'what' to learn about electro-therapeutics that there is about opium, aconite, mercury, strychnine, belladonna, iron, arsenic, cod liver oil, iodide of potassium, digitalis, heat, cold and 'new-remedy' therapeutics *all combined,*—indications, contra-indications, preparation (type of current), polarity, choice of elec-

trodes, *regulation of dosage*, method of administration, duration of seance, frequency of treatment, idiosyncrasies, by-effects, control of conditions, mechanism, influence of superficial and deep complications; physics, physiology, pathology, therapeutics and the training of the eye, ear and both hands.

"SKILL is the whole value of electrical apparatus. Poor skill—poor results. Trained skill—results in proportion. It is a question of 'know how.'

"Is it hard to learn the 'KNOW HOW'? No one who will reflect upon the labor of making a good surgeon, the cost of his tools, the work and care of cleaning them, and the difficulties of operating, yet the great number of surgeons there are can sustain any argument about the 'cost' and 'trouble' of skilled electro-therapeutics. In both cases the immense possibilities for humanity *compel the profession to advance;* and in the average life above the lower social grades, the practical services and value of scientific (not crude) electro-therapeutics *exceeds a hundred fold* the demands for the most brilliant surgery. All clinical experience maintains that the sum of ordinary office practice is made up of relieving commonplace sufferings, and the treatment of frequent and not rare diseases. Not everyone need attempt to exhaust the full possibilities of electric currents, but every general practitioner (and the majority of specialists or their assistants) can learn how to make profitable employment of selected methods most useful to his clientele.

"Most men who buy a battery and *use it without instruction lose more than they imagine*, or obviously they would not continue the loss.

"Every person who uses an electric battery *without preparatory study and special experience* is likely to use it badly, and disappoint both patient and himself. He may diagnose diseases at sight, report cures of all sorts and cite long lists of operations without a death, but when he first undertakes *electro-therapeutics* he is on a par with

every other *beginner*, and must study current actions, differences, dosage, indications and technique. After he learns the theoretical foundation he must *practice* industriously to obtain *skill.* If he does this he will please and benefit most of his patients, and will not annoy or wholly disappoint any."

THE END.

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To the medical profession, and especially to all employing the static machine and who have waited so long without an authoritative work upon the subject, this book is a mine of essential information.

"This useful volume is one that every physician and surgeon who is interested in the medical applications of electricity shonld possess. It is the only work of the kind in the language, and as a pioneer production is remarkably complete in its details and thorough in its descriptions. To one who has neglected the study of this phase of medical science, the great results described, and the multitude of ailments that can be benefited will prove quite a revelation."—*American Medico-Surgical Bulletin.*

EXTRACTS FROM REVIEWS OF "THE TREATMENT OF DISEASE BY ELECTRIC CURRENTS."

"When Professor Monell issued his work upon static electricity, it was taken up by the medical profession as few books upon electro-therapeutics have been, and almost from the day of issue became the work of reliable reference with not only multitudes of general practitioners, but also with the specialists in this line of medicine, and especially with the medical teachers of America. When the announcement was made some weeks ago that a general work upon the entire subject of electricity in medicine was in process of preparation by Dr. Monell, a stir of interest passed over the profession, and the mere announcement that the work has now been published will bring for it a very large sale. The work stands forth as one of the most striking medical productions of 1897."—*Medical Sentinel.*

"To the average medical man this volume will prove a revelation of a most remarkable kind. While all have a general knowledge of the fact that electricity can be used to great advantage in some diseases, but few are aware of the vast scope of usefulness it can subserve. We could not in the short space allotted us for this review give a tithe of the names of complaints benefited by this mode of treatment according to the author. His enthusiasm, too, is contagious, for as the reader proceeds he is unconsciously carried away into believing without seeing. He is a clear, forceful writer, and puts his subject before the reader in a way that cannot be misunderstood. His directions are all examples of perfect lucidity and just such as the practitioner needs when beginning the study of so fascinating a subject. The work of a good static machine and of a family battery is absolutely as incomparable as the medical advice of an Olser with that of a savage. This book should be in the hands of every person interested in electro-therapeutics."—*American Medico-Surgical Bulletin.*

"Every page of the book is *practical therapeutics.* Every chapter is a clinic in itself. It is a book that physicians have long desired, and is the first work upon the subject which presents in a single volume the special and comparative merits of all forms of medical currents. To the practitioner who seeks to inform himself of therapeutic development for consultation purposes, or for personal use of electrical apparatus, this volume is practically indispensable."—*The Medical Brief.*

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"It would be impossible for us to specialize the headings of the seventy chapters in this volume in the space allotted for this review, therefore it must suffice to state that every known modern employment for faradic, galvanic, and static electricity, and their therapeutic indications, are detailed in this volume with *conciseness of language* and *minute directions of application* so that the general practitioner who runs may read and understand."

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The Medical Fortnightly: "The minute and careful description of apparatus and methods, together with the vast amount of practical clinical suggestions, gives to Dr. Monell's work a unique and valuable place in medical literature."

The American Medical Journal: "This book will be sought after by many."

The Atlanta Medical and Surgical Journal: "The work is truly interesting and instructive. We are prepared to accept the author's statements, knowing the marvellous static current as we do."

British Medical Journal: "There is much good matter in it."

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Pacific Medical Journal: "The medical profession is indebted to Dr. Monell for the first scientific work which has appeared on static electro-therapeutics and the X-Ray."

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